



Environmental Strategy & Engineering  
One Monarch Drive, Suite 201  
Littleton, Massachusetts 01460  
Tel. (978) 679-1600  
Fax (978) 679-1601

## PROJECT MEMORANDUM

To: Alex Sherrin, USEPA                          From: Michael J. Webster and Christene Binger  
  
Date: May 8, 2019                                  Project No. 2491-001  
  
Re: Summary of Activities  
60 Olympia Avenue  
Woburn, Massachusetts

---

### OVERVIEW

This Project Memorandum provides an overview of remedial and monitoring activities conducted at the 60 Olympia Avenue site between October 2016 and November 2018. The results of historical groundwater sampling events are summarized in Table 1. The results of these groundwater sampling events have been used to guide and focus remedial injection events. The volumes of permanganate solution injected during each event are summarized in Table 2.

The initial approach in 2005 was broad treatment and injection with the treatment cell. The treatment cell consists of a sheet pile wall extending to 20 feet below grade that contains an area approximately 60 feet wide by 150 feet in length (see Figure 1). A portion of the downgradient side of the treatment cell extends to 25 feet below grade. During the initial field injection season in 2005, gravity drainage delivery methods were used over a 4-month period to deliver concentrated (i.e., 40 percent) permanganate solution into the two stratigraphic layers within the treatment cell. The two stratigraphic layers consist primarily of a sand layer (shallow layer) and an underlying silt layer (deeper layer). The sand layer varies in thickness and has been typically observed to extend to 6 to 8 feet below ground surface (BGS). The underlying silt layer extends to depths of approximately 20 to 22 feet BGS. During subsequent field injection seasons (2007 to 2018), additional permanganate solution was injected within the treatment cell using direct-push geoprobe and manual gravity drainage methods.

Monitoring events typically include observations of purple color in monitoring and injection wells and collecting samples from monitoring wells for laboratory analysis for volatile organic



compounds (VOCs). The samples collected were preserved with hydrochloric acid and if permanganate was present in the sample collected for analysis, the permanganate solution in each sample was neutralized using ascorbic acid. Purple color is rated on a scale from 0 to 4, with 0 having no color, and 4 being opaque and black in color. Trichloroethylene (TCE) concentration vs. time plots are included as Attachment A.

Between 2016 and 2018, permanganate solution was injected into localized areas within and near the treatment cell to address specific areas, including the area just outside the east side of the cell. The permanganate solution was injected using manual and direct-push methods. Monitoring is generally performed prior to injection events to identify areas to focus the injection. Monitoring is also performed during injections to monitor real-time changes in nearby monitoring points. Typically, injection events are focused in areas that indicate increases in VOC concentrations and less dependent on permanganate saturation strength, especially if an area had already achieved a 3 or 4 on the color scale.

Also, during this monitoring period, a focused subsurface assessment was performed in June 2018 that included continuous vertical profiling using Membrane Interface Hydraulic Profile Technology (MiHPT).

## **SUMMARY OF ACTIVITIES – DECEMBER 2016 to NOVEMBER 2018**

### **December 2016 – Injection Event**

Following the October 18, 2016 monitoring event that was described in the November 29, 2016 project memorandum, a focused remedial injection event was performed on December 14 and 15, 2016. The injection method used was gravity drainage into injection wells and existing trenches. 40% sodium permanganate solution was diluted to 2% to 4% solutions for injection. Approximately 870 gallons of permanganate solution was injected during the two-day injection event. Injection activities targeted injection wells in the vicinity of monitoring wells MW-201D, MW-206D, MW-208D, MW-210S, MW-212S and MW-217M.

### **February 2017 – Monitoring Event**

A comprehensive purple check and sampling event was performed on February 21, 2017. During this event, groundwater samples were collected from all MW-200 series monitoring wells (49 wells total).

### **April 2017 – Injection Event**

Based upon review of permanganate distribution and the presence of VOC detected during the February 2017 monitoring event, a focused remedial injection event was conducted on April 18 and 19, 2017. The injection method used was gravity drainage into injection wells and existing trenches. 40% sodium permanganate solution was diluted to 1% to 5% solutions for injection. Approximately 1,210 gallons of permanganate solution was injected during the two-day injection event.

The injection event focused on the presence of VOCs near the southeast corner (MW-217 area) of the containment cell. For the MW-217 area, injection activities focused on the injection wells



J-4 and J-5, located outside the southeastern corner of the containment cell. In addition, focused injection was performed near monitoring wells MW-201D, MW-206D, MW-208D, MW-210S and MW-212S.

### **May and June 2017 – Monitoring Events**

On May 10, 2017, focused purple checks were performed to evaluate conditions near MW-217M following the April 2017 injection. The presence of permanganate was evaluated in injection wells J4, J5, and OL-2M. Groundwater samples were collected from monitoring wells MW-201S, MW-201D, MW-206D, MW-208D, MW-210S and MW-217M. The presence of permanganate was noted in the monitoring wells that were sampled.

On June 29, 2017, focused purple checks and sampling were performed to evaluate conditions near MW-217M. The presence of permanganate was evaluated in injection wells J-4 and J-5, and in monitoring wells MW-211S, MW-211D, MW-217S, MW-217M, and MW-217D. A groundwater sample was collected from MW-217M.

### **August 2017 – Injection Event**

A focused injection event was performed on August 30 and 31, 2017. Gravity drainage was the method used to inject permanganate into injection wells and existing trenches. 40% sodium permanganate solution was diluted to 4% solutions for injection. Approximately 700 gallons of permanganate solution was injected during the two-day injection event.

The injection event was focused near the southeast corner of the containment cell utilizing injection wells J-4 and J-5. Other targeted areas were treated by using existing trenches and injection wells to gravity drain permanganate solution to the areas of MW-201D, MW-206D, MW-207S, MW-208D and MW-211S using a drum pump or peristaltic pump.

### **October 26, 2017 – Monitoring Event**

A focused purple check and sampling event was performed on October 26, 2017. During this event, MW-200 series monitoring wells were evaluated for the presence of permanganate. In addition, groundwater samples were collected from 11 monitoring wells including MW-201S, MW-201D, MW-202S, MW-206D, MW-207S, MW-208D, MW-211D, MW-212S, MW-213S, MW-215M, and MW-217M.

### **November 2017 – Injection Event**

Data from the October 2017 sampling and purple check event were evaluated in preparation for an injection event. A focused remedial injection event was performed on November 28 and 29, 2017. Gravity drainage was the method utilized to inject into injection wells, existing trenches, and shallow injection points advanced via hand auger. 40% sodium permanganate was diluted to solutions that ranged in concentration from 2 to 5% for injection. Approximately 1,075 gallons of permanganate solution was injected during this two-day event. Injection wells located near the southeast corner of the cell were the primary focus of this injection event. Also, for this injection event, shallow boreholes (approximately 3 feet deep)



were advanced using a hand auger to facilitate injection of permanganate solution into two shallow areas near monitoring wells MW-207S and MW-212S. Three feet of 2-inch diameter, 10-slot PVC screen were inserted into the boreholes and used as injection points. These injection points were used to treat shallow groundwater near wells with elevated concentrations of VOCs.

### **February 27, 2018 – Monitoring Event**

A focused monitoring event was performed on February 27, 2018 to evaluate for the presence of sodium permanganate and concentrations of VOCs in monitoring well MW-217M.

### **March 23, 2018 – Monitoring Event**

A focused purple check and sampling event was performed on March 23, 2018 to evaluate select monitoring wells and injection wells for the presence of sodium permanganate. During this event groundwater samples were collected from monitoring wells MW-201D, MW-206D, MW-207S, MW-208D, MW-211D, MW-217M, OL-2M, MW-011S and MW-011I.

### **June 22, 2018 – Subsurface Investigation**

Focused assessment activities were performed on June 22, 2018 and included the use of MiHPT to advance boreholes and perform vertical profiling in five areas. Below is a brief summary of the approach. Results will be summarized in a separate summary memorandum.

- The objective of the event was to assess the area of MW-217M to evaluate the presence of VOCs and permanganate observed at a depth of 25 to 28 feet near the containment cell wall. The depth of the containment wall in this area is approximately 25 feet;
- The event included evaluation of five locations upgradient, side gradient, inside and outside of the containment cell, and within 10 feet of MW-217M to identify the depth and distribution of sodium permanganate and VOCs in the MW-217 area;
- Data was collected continuously, in the upper sand unit (0 to 8 feet), through the predominant silt layer (8 to 22 feet), and into the underlying sandy unit to a total depth of 30 feet at each boring location; and
- Information from the boring profiles was used to focus fall 2018 injection activities.

### **October 12, 2018 – Monitoring Event**

A focused monitoring event was performed on October 12, 2018 to evaluate for the presence of sodium permanganate and concentrations of VOCs in groundwater from monitoring wells MW-218M, MW-219M, and OL-3M.

### **November 2018 – Injection Event**

A focused remedial injection event was performed on November 15 and 16, 2018 following the June 22, 2018 subsurface investigation. Data were used from the subsurface investigation to



target areas primarily inside the southern and southeastern portions of the cell. Direct-push methods were utilized as the injection method. 40% sodium permanganate was diluted to a concentration of approximately 2 to 4% for injection. Approximately 4,240 gallons of permanganate solution were injected during this two-day event.

In total, nine locations were targeted at depths ranging from 12 to 24 feet below grade surface. Figure 2 is attached illustrating current and historical direct-push injection locations.

### **Summary of Groundwater Monitoring – February 2017 to November 2018**

Remedial efforts have significantly reduced TCE concentrations in the MW-200 series monitoring wells. In general, when TCE was reduced to low concentrations and unreacted permanganate was observed, treatment was reduced, and monitoring was performed. Areas that exhibited fluctuating TCE concentrations were identified for focused injection activities to treat the localized area. Between December 2016 and November 2018, seven monitoring events, five injection events and one subsurface investigation occurred.

### **2019 ACTIVITIES**

A comprehensive monitoring event was performed in April 2019. During this event, injection wells and the MW-200 series were checked for presence of permanganate and groundwater samples were collected from the MW-200 series monitoring wells for VOC analysis. The data are currently under review.

Enclosures:

### **TABLES**

Table 1 - Summary of Groundwater Analytical Data – Primary VOCs

Table 2 - Summary of Sodium Permanganate Injection Events

### **FIGURES**

Figure 1 - Site Plan

Figure 2 - Direct-Push Injection Locations

### **ATTACHMENT**

Attachment A - Sodium Permanganate and TCE Concentration vs. Time Plots



## TABLES

**TABLE 1**  
**SUMMARY OF GROUNDWATER ANALYTICAL DATA - PRIMARY VOCs**  
**60 OLYMPIA AVENUE**  
**WOBBURN, MASSACHUSETTS**

Location Identification	Sampling Date	Screen Interval (feet)	Color	Tetrachloroethene	Trichloroethene	cis-1,2-Dichloroethene	Vinyl Chloride
				Groundwater Standards			
				5	5	70	2
<b>INSIDE CONTAINMENT CELL</b>							
OL-002 (DUP)	12/15/87	4-9'	---	41	3,100	---	---
	12/15/87		---	33	3,400	---	---
	09/16/97		---	8	3,700	3	<1
	03/20/02		---	<120	7,900	<120	<120
	03/20/02		---	<120	8,000	<120	<120
	04/22/03		---	3	91	4	<1
	06/02/03		---	<5	330	17	<5
	04/14/05		---	<50	3,200	76	<100
	04/22/08		0	<10	79	<10	<10
	04/07/09		1	<3	41	<3	<3
OL-2	10/18/11		0	<20	37	22	<20
	04/17/12		0	<10	52	14	<10
	03/07/13		0	<2	22	15	<2
	03/21/14		1	<5	2.5	5.4	<5
	07/09/02	21.5-31.5'	---	<0.1	5	<2	<0.1
OL-2M OL-2M (DUP-3)	06/02/03		---	<0.5	<0.5	<0.5	<0.5
	04/14/05		---	<1	<1	<1	<2
	01/11/06		---	<25	1,600	<25	<25
	02/09/06		---	<250	22,000	<250	<250
	03/10/06		---	<25	1,800	<25	<25
	04/24/06		---	<5	400	<5	<5
	04/24/06		---	<5	430	<5	<5
	07/19/06		---	1	80	<0.5	<0.5
	08/31/06		---	<1	34	<1	<1
	09/28/06		---	0.7	25	<0.5	<0.5
	12/14/06		0	0.8	37	<0.5	<0.5
	03/28/07		0	6	260	<5	<5
	04/24/07		0	<10	690	<10	<10
	04/22/08		0	<0.5	3	<0.5	<0.5
	04/07/09		1	1	2	<0.5	<0.5
	03/07/13		0	<1	3.8	<1	<1
GEO-4	03/21/14		0	<1	7.1	<1	<1
	10/05/15		0	<1	5.3	<1	<1
	03/23/18		0	<1	19	1.9	<1
	06/24/03	6-16'	---	<5	340	<5	<5
	04/14/05		---	<50	2,500	<50	<100
TEST-1 TEST-1 (Field Dup D02947) TEST-1 (DUP-5)	07/19/06		0	<0.5	<0.5	<0.5	<0.5
	04/07/09		2	<25	<25	<25	<25
	03/07/13		2	<20	<20	<20	<20
	03/21/14		3	<10	36	<10	<10
	07/09/02	1.8-16.8'	---	14	12,000	15	2
	07/09/02		---	15	12,000	15	2
Test 1	06/02/03		---	3	1,300	130	3
	06/24/03		---	<5	400	53	<5
	04/14/05		---	<50	3,500	390	<100
	04/14/05		---	<50	3,600	400	<100
	04/08/09		1	<0.5	<0.5	<0.5	<0.5
OL-003 OL-3 OL-003	04/17/12		2	<1	<1	<1	<1
	03/07/13		2	<1	<1	<1	<1
	03/21/14		2	<1	<1	<1	<1
	12/15/87	4-9'	---	45	180	23	ND
OL-003 OL-3M MW-200S	09/16/97		---	5	94	280	95
	03/18/02		---	0.508 (J)	13	57	16
	06/02/03		---	0.8	2	11	7
	04/13/05		---	<25	930	480	77
	04/24/08		0	13	370	450	82
	04/07/09		3	<25	<25	<25	<25
	03/07/13		1	<1	2.4	10	<1
	03/21/14		0	<1	<1	1.3	2.2
	07/10/02	21.5-31.5'	---	<0.1	0.191	<2	<0.1
	06/02/03		---	<0.5	<0.5	<0.5	<0.5
GEO-3 MW-200S MW-200D MW-200D (Dup)	04/13/05		---	<1	<1	<1	<2
	04/07/09		4	<3	<3	<3	<3
	03/07/13		1	3.6	7.1	<2	<2
	03/21/14		3	<10	<10	<10	<10
	10/12/18		3	<2	2.7	<2	<2
	06/24/03	6-16'		<0.5	4	49	35
	04/14/05	6.5-9.5'	---	<200	14,000	<200	<400
MW-200D MW-200D (Dup) MW-201S	04/07/09		4	<25	<25	<25	<25
	03/23/11		3	<50	<50	<50	<50
	03/07/13		3	<100	<100	<100	<100
	04/13/16		2	<20	<20	<20	<20
	02/21/17		2	<100	<100	<100	<100
	04/14/05	14-17'	---	<25,000	870,000	<25,000	<25,000
	04/14/05		---	<25,000	770,000	<25,000	<25,000
	04/07/09		4	<50	<50	<50	<50
	02/15/10		4	<250	<250	<250	<250
	03/23/11		4	<500	<500	<500	<500
MW-201S	03/07/13		3	<10	<10	<10	<10
	03/21/14		3	<50	<50	<50	<50
	02/21/17		4	<50	<50	<50	<50
	04/14/05	6.5-9.5'	---	<5	330	<5	<10
	11/05/07		---	<2.5	4	<2.5	<2.5
	04/24/08		2	<10	5	<10	<10
	03/23/11		0	<0.5	4	<0.5	<0.5
	03/07/13		2	<5	<5	<5	<5
	03/21/14		2	<10	14	<10	<10
	09/29/14		1	<1	6.8	<1	<1
MW-201S	02/21/17		0	<10	400	<10	<10
	05/10/17		1	2.0	95	<2	<2
	10/26/17		1	<1	9.5	2.3	<1

**TABLE 1**  
**SUMMARY OF GROUNDWATER ANALYTICAL DATA - PRIMARY VOCs**  
**60 OLYMPIA AVENUE**  
**WOBBURN, MASSACHUSETTS**

Location Identification	Sampling Date	Screen Interval (feet)	Color	Tetrachloroethene	Trichloroethene	cis-1,2-Dichloroethene	Vinyl Chloride
				Groundwater Standards			
				5	5	70	2
MW-201D	04/14/05	14-17'	---	<1	11	<1	<2
	11/05/07			<5	<5	<5	<5
	03/23/11		2	<100	9,300	<100	<100
	10/18/11			110	18,000	120	<100
	08/24/12		4	6.8	11	<5	<5
	03/07/13			1	350	<10	<10
	07/31/13		1	<50	4,300	50	<50
	03/21/14			2	120	<10	<10
	09/29/14		1	<20	2,200	48	<20
	05/12/15			2	35	<10	<10
	10/05/15		2	<5	710	16	<5
	10/18/16			0	7.7	1.3	<1
	02/21/17		0	<20	2,000	23	<20
	05/10/17			<5	370	8.7	<5
	10/26/17		1	<25	3,900	57	<25
	03/23/18			<1	26	<1	<1
MW-202S	04/14/05	6.5-9.5'	---	<100	6,200	<100	<200
	04/22/08			3	<25	<25	<25
	03/07/13			0	20	<20	<20
	07/31/13			0	50	<50	<50
	03/21/14			0	1,600	<10	<10
	07/15/14			0	1,300	<20	<20
	05/12/15			0	2,300	<10	<10
	10/05/15			---	820	<10	<10
	04/13/16			---	690	<10	<10
	10/18/16			0	290	<10	<10
	02/21/17			0	220	<10	<10
	10/26/17			---	160	<50	<50
	---			<1	49	<1	<1
MW-202D	04/14/05	14-17'	---	<2,000	89,000	<2,000	<4,000
	04/07/09			4	<100	<100	<100
	11/03/09			4	<100	<100	<100
	03/23/11			4	<250	<250	<250
	03/07/13			3	<10	<10	<10
	03/21/14			4	<100	<100	<100
	02/21/17			4	<200	<200	<200
MW-203S	04/14/05	3-6'	---	<10	500	<10	<20
	04/25/07			0	0.5	0.7	<0.5
	11/05/07			---	0.5	0.7	<0.5
	04/23/08			0	0.5	39	<0.5
	04/07/09			0	0.5	4	<0.5
	03/23/11			0	0.5	3	<0.5
	03/07/13			2	40	83	<40
	07/31/13			0	1	3.8	<1
	03/21/14			0	1	2.5	<1
	10/05/15			0	10	130	<10
	04/13/16			---	1	2.2	<1
	02/21/17			0	1	1.8	<1
MW-203D	04/14/05	14-17'	---	<500	42,000	<500	<1,000
	08/31/06			1	250	24,000	<250
	12/14/06			2	120	<5	<5
	11/05/07			---	<500	33,000	<500
	04/24/08			0	250	26,000	<250
	08/06/08			0	<250	37,000	<250
	11/13/08			4	<250	47,000	<250
	12/11/08			3	<25	<25	<25
	03/09/09			2	200	14,000	<100
	11/03/09			0	350	45,000	<250
	02/15/10			3	30	<25	<25
	09/01/10			2	<130	<25	<25
	03/23/11			2	120	12,000	<100
	10/18/11			1	<100	3,200	<100
	04/17/12			2	69	6,800	<25
	08/24/12			4	18	64	<5
	03/07/13			0	<1	<1	<1
	07/31/13			3	<50	3,000	<50
	03/21/14			2	<10	54	<10
	09/29/14			1	26	2,000	<20
	05/12/15			3	<20	<20	<20
	10/05/15			0	<5	26	<5
	02/21/17			3	<25	<25	<25
MW-204S MW-204S (DUP-8)	04/14/05	7-10'	---	<50	2,400	280	<100
	04/14/05			---	<50	250	<100
	04/23/08			2	<250	<250	<250
	04/07/09			3	<10	<10	<10
	03/23/11			3	<0.5	<0.5	<0.5
	03/07/13			2	<50	<50	<50
	03/21/14			2	<10	<10	<10
	02/21/17			1	<20	<20	<20
MW-204D	04/14/05	14-17'	---	<1,000	60,000	<1,000	<2,000
	04/25/06			0	2,500	190,000	<2,500
	07/19/06			0	2,500	160,000	<2,500
	08/31/06			0	2,500	220,000	<2,500
	09/28/06			0	2,500	210,000	<2,500
	04/25/07			0	5,000	260,000	<5,000
	04/24/08			1	2,500	460,000	<2,500
	08/06/08			2	2,500	190,000	<2,500
	11/13/08			2	<500	70,000	<500
	03/09/09			4	<50	<50	<50
	04/08/09			3	<100	<100	<

**TABLE 1**  
**SUMMARY OF GROUNDWATER ANALYTICAL DATA - PRIMARY VOCs**  
**60 OLYMPIA AVENUE**  
**WOBBURN, MASSACHUSETTS**

Location Identification	Sampling Date	Screen Interval (feet)	Color	Tetrachloroethene	Trichloroethene	cis-1,2-Dichloroethene	Vinyl Chloride
				Groundwater Standards			
				5	5	70	2
MW-205S	04/13/05	4-7'	---	<1	12	4	<2
	10/30/06			<0.5	2	8	<0.5
	04/23/08			<0.5	5	5	1
	04/23/08			<0.5	4	4	0.9
	04/07/09			<0.5	<0.5	<0.5	<0.5
	03/23/11			<0.5	3	5	1
	MW-205SX			<0.5	3	5	1
	03/23/11			<1	<1	13	8.6
	MW-205SX			<1	<1	13	8.6
	03/07/13			<1	1.9	7.2	2.6
MW-205SX	03/21/14	0	<1	<1	1.8	7	2.4
	03/21/14			<1	1.6	7	<1
	10/05/15			<1	4.9	4.4	3
	02/21/17			<1			
MW-205D	04/13/05	14-17'	---	<500	16,000	<500	<1,000
	04/26/06			0	61,000	<1,000	<1,000
	07/19/06			0	98,000	<2,500	<2,500
	08/31/06			0	110,000	<2,500	<2,500
	09/28/06			0	120,000	<2,500	<2,500
	10/30/06			0	120,000	<1,000	<1,000
	04/25/07			0	120,000	<2,500	<2,500
	04/23/08			1	340	25,000	<250
	08/06/08			4	<25	<25	<25
	11/13/08			4	<50	<50	<50
	03/09/09			4	<100	<100	<100
	11/03/09			4	<100	<100	<100
	09/01/10			4	<250	<50	<50
	03/23/11			4	<100	<100	<100
	03/23/11			4	<100	<100	<100
	MW-205DX			4	<100	<100	<100
	10/18/11			4	<100	<100	<100
	MW-205DX			4	<250	<250	<250
	03/07/13			3	<20	<20	<20
	MW-205DX			3	<20	<20	<20
	03/21/14			4	<10	<10	<10
	MW-205DX			4	<20	<20	<20
	02/21/17			2	<100	<100	<100
MW-206S	04/14/05	4-7'	---	<100	8,200	130	<200
	04/23/08			1	<5	<5	<5
	03/23/11			3	<0.5	<0.5	<0.5
	03/11/13			2	<1	<1	<1
	03/21/14			3	<1	<1	<1
	02/21/17			0	<5	<5	<5
MW-206D	04/14/05	14-17'	---	<25	<25	70	<50
	04/26/06			0	81,000	<1,000	<1,000
	07/19/06			0	73,000	<1,000	<1,000
	08/31/06			0	78,000	<1,000	<1,000
	09/28/06			0	87,000	<1,000	<1,000
	04/25/07			0	83,000	<1,000	<1,000
	04/23/08			0	500	100,000	<50
	04/23/08			0	<1,000	77,000	<1,000
	08/06/08			2	320	870	<3
	11/13/08			3	<500	78,000	640
	12/11/08			3	<25	<25	<25
	03/09/09			2	200	<50	<50
	11/03/09			2	330	14,000	<100
	02/15/10			2	260	9,200	<50
	09/01/10			1	210	34,000	<3
	03/23/11			1	150	17,000	<100
	10/18/11			0	<500	13,000	<500
	04/17/12			0	72	8,400	<25
	08/24/12			0	<200	10,000	<200
	03/07/13			1	<100	4,400	<100
MW-206D-DUP	07/31/13			1	<100	5,800	<100
	03/21/14			0	42	3,700	<40
	03/21/14			0	45	3,600	<10
	07/15/14			0	46	4,000	<25
	05/12/15			0	<20	1,700	<20
	10/05/15			0	29	2,400	<25
	04/13/16			2	<10	400	<10
	10/18/16			1	<20	1,200	<20
	02/21/17			1	<25	680	<25
	05/10/17			1	<10	200	<10
	10/26/17			0	<10	1,000	<10
	03/23/18			0	<10	530	<10
MW-207S	04/13/05	6-9'	---	110	3,700	1,700	320
	12/14/06			1	<10	550	<10
	11/05/07			---	<25	890	54
	04/22/08			0	83	1,700	51
	08/06/08			2	62	39	<5
	04/07/09			2	<10	<10	<10
	03/23/11			1	25	930	61
	10/18/11			0	<20	970	<20
	08/24/12			0	<40	2,000	810
	03/07/13			1	11	130	10
	07/31/13			1	<10	160	27
	03/21/14			0	<20	1,700	74
	07/15/14			0	<10	550	16
	05/12/15			0	<20	1,700	<20
	10/05/15			0	<20	3,200	1,300
	04/1						

**TABLE 1**  
**SUMMARY OF GROUNDWATER ANALYTICAL DATA - PRIMARY VOCs**  
**60 OLYMPIA AVENUE**  
**WOBBURN, MASSACHUSETTS**

Location Identification	Sampling Date	Screen Interval (feet)	Color	Tetrachloroethene	Trichloroethene	cis-1,2-Dichloroethene	Vinyl Chloride
				Groundwater Standards			
				5	5	70	2
MW-208S	04/14/05	4-7'	---	<25	<b>1,100</b>	<b>1,300</b>	<b>95</b>
	04/22/08			<25	<25	<25	<25
	04/07/09			<10	<10	<10	<10
	03/23/11			<0.5	<0.5	<b>1</b>	<0.5
	03/07/13			<1	<1	<b>2.8</b>	<b>1.7</b>
	03/21/14			<1	<1	<1	<1
	02/21/17			<1	<b>6.9</b>	<b>18</b>	<b>9.6</b>
MW-208D	04/14/05	14-17'	---	<500	<b>38,000</b>	<500	<500
	12/14/06			<2,500	<b>170,000</b>	<2,500	<2,500
	12/11/08			<25	<25	<25	<25
	03/09/09			<100	<100	<100	<100
MW-208DX	11/03/09			<b>40</b>	<25	<25	<25
	09/01/10			<b>250</b>	<b>73</b>	<50	<50
MW-208 (DUP-1)	09/01/10			<2,500	<b>91,000</b>	<500	<500
DUP-2	03/23/11	---	3	<b>500</b>	<b>64,000</b>	<500	<500
	10/18/11			<b>380</b>	<b>36,000</b>	<b>410</b>	<100
	10/18/11			<500	<b>38,000</b>	<500	<500
	04/17/12			<b>300</b>	<b>23,000</b>	<b>280</b>	<50
	08/24/12			<b>290</b>	<b>22,000</b>	<b>270</b>	<250
	03/07/13			<250	<b>12,000</b>	<b>320</b>	<250
	03/07/13			<200	<b>11,000</b>	<b>290</b>	<200
MW-208D-DUP	07/31/13	---	0	<400	<b>11,000</b>	<400	<400
	03/21/14			<b>210</b>	<b>8,000</b>	<b>590</b>	<50
	03/21/14			<b>160</b>	<b>8,200</b>	<b>670</b>	<50
	07/15/14			<b>230</b>	<b>7,400</b>	<b>520</b>	<100
	05/12/15			<b>84</b>	<b>2,200</b>	<b>690</b>	<25
	10/05/15			<b>120</b>	<b>2,700</b>	<b>510</b>	<25
	04/13/16			<b>50</b>	<b>570</b>	<b>350</b>	<10
MW-209S	10/18/16	---	0	<100	<b>880</b>	<b>500</b>	<100
	02/21/17			<100	<b>500</b>	<b>380</b>	<100
	05/10/17			<b>23</b>	<b>210</b>	<b>210</b>	<10
	10/26/17			<b>24</b>	<b>310</b>	<b>240</b>	<5
	03/23/18			<b>20</b>	<b>100</b>	<b>94</b>	<10
MW-209D	04/13/05	14-17'	---	<10	<b>520</b>	<b>1,200</b>	<b>270</b>
	04/22/08			<5	<b>22</b>	<5	<5
	04/07/09			<b>2</b>	<5	<5	<5
	03/23/11			<10	<b>44</b>	<10	<10
	10/18/11			<b>1.4</b>	<b>34</b>	<b>1.00</b>	<1
	03/07/13			<10	<10	<10	<10
	07/31/13			<10	<10	<10	<10
MW-210S	03/21/14	---	0	<10	<b>11</b>	<10	<10
	02/21/17			<b>10</b>	<b>130</b>	<10	<10
	10/05/15			<20	<b>49</b>	<20	<20
	04/13/16			<10	<b>140</b>	<10	<10
	02/21/17			<10	<10	<10	<10
MW-210D	04/14/05	14-17'	---	<25	<b>1,600</b>	<25	<50
	04/07/09			<10	<5	<10	<10
	03/23/11			<10	<5	<10	<10
	03/21/14			<10	<b>24</b>	<b>14</b>	<10
	02/21/17			<5	<b>49</b>	<b>53</b>	<5
MW-211S	04/13/05	7-10'	---	<50	<b>730</b>	<b>3,500</b>	<b>1,100</b>
	11/05/07			<25	<b>430</b>	<b>1,000</b>	<b>61</b>
	04/22/08			<25	<b>2,400</b>	<b>2,900</b>	<b>290</b>
	08/06/08			<25	<25	<25	<25
	04/07/09			<b>3</b>	<b>30</b>	<0.5	<0.5
	09/01/10			<b>2</b>	<5	<5	<5
	03/23/11			<b>2</b>	<b>18</b>	<b>4</b>	<b>&lt;3</b>
MW-211D	10/18/11	---	0	<5	<5	<5	<5
	03/07/13			<1	<b>14</b>	<b>13</b>	<b>1.6</b>
	07/31/13			<5	<b>130</b>	<b>210</b>	<b>11</b>
	03/21/14			<b>4</b>	<1	<1	<1
	02/21/17			<10	<b>930</b>	<b>1,000</b>	<b>200</b>
	05/10/17			<4	<4	<b>6</b>	<4
	02/21/17			<10	<10	<b>710</b>	<b>270</b>
MW-211S	04/14/05	6.5-9.5'	---	<2	<b>39</b>	<b>140</b>	<b>27</b>
	12/14/06			<0.5	<b>1</b>	<b>2</b>	<b>0.6</b>
	04/25/07			<0.5	<b>1</b>	<b>0.7</b>	<0.5
	04/22/08			<0.5	<b>2</b>	<b>2</b>	<b>0.8</b>
	09/01/10			<3	<b>0.5</b>	<0.5	<0.5
	03/23/11			<0.5	<0.5	<b>0.6</b>	<0.5
	03/07/13			<1	<1	<b>1.2</b>	<1
MW-211D	03/21/14	---	0	<1	<1	<1	<1
	02/21/17			<1	<1	<1	<1
	09/29/14			<40	<b>110</b>	<b>4,800</b>	<40
	02/21/17			<100	<b>430</b>	<b>11,000</b>	<b>610</b>
	10/26/17			<100	<b>580</b>	<b>16,000</b>	<b>1,000</b>
	03/23/18			<50	<b>540</b>	<b>9,200</b>	<b>530</b>

**TABLE 1**  
**SUMMARY OF GROUNDWATER ANALYTICAL DATA - PRIMARY VOCs**  
**60 OLYMPIA AVENUE**  
**WOBBURN, MASSACHUSETTS**

Location Identification	Sampling Date	Screen Interval (feet)	Color	Tetrachloroethene	Trichloroethene	cis-1,2-Dichloroethene	Vinyl Chloride
				Groundwater Standards			
				5	5	70	2
MW-212S	04/14/05	10-13'	---	450	360	12	<20
	04/26/06			0,1200	2,300	<25	<25
	08/31/06			0,1300	2,200	39	<25
	09/28/06			0,240	1,000	310	<25
	10/30/06			0,1300	1,900	42	<25
	04/26/07			0,1200	1,800	68	<25
	04/24/08			0,1100	2,100	200	<25
	04/08/09			3	<25	<25	<25
	03/23/11			0,1200	1,600	21	<10
	10/18/11			0,1300	2,500	<50	<50
	03/07/13			2	2.4	3.0	<1
	03/21/14			1	<10	11	<10
	09/29/14			0	<1	<1	<1
	02/21/17			1	12	410	<10
	10/26/17			0	15	1,600	<10
<b>DEEP OVERBURDEN WELLS</b>							
GEO-1	09/21/99	90-100'	---	<1.5	2.5	<1	<2
	03/18/02			0.104	0.244	<2	<0.1
	09/13/05			<0.5	<0.5	<0.5	<0.5
	01/11/06			<0.5	<0.5	<0.5	<0.5
	04/24/06			<0.5	<0.5	<0.5	<0.5
	04/24/07			<0.5	<0.5	<0.5	<0.5
GEO-2	09/21/99	95-105'	---	<1.5	1.6	<1	<2
	03/15/02			<0.1	0.175	<2	<0.1
<b>OUTSIDE CONTAINMENT CELL UPGRADE</b>							
OL-005	12/15/87	3.5-8.5'	---	ND	ND	---	---
	03/19/02			<0.1	<1,000	<2	<0.1
	06/02/03			<0.5	<0.5	<0.5	<0.5
	04/14/05			<1	<1	<1	<2
	04/25/06			0,0.5	<0.5	0.5	<0.5
	04/24/07			0	32	7	<0.5
MW-12	07/10/02	3.5-13.5'	---	<0.1	<0.1	<2	<0.1
	04/14/05			<1	<1	<1	<2
	04/25/06			<0.5	<0.5	<0.5	<0.5
	04/24/07			0,0.5	13	0.5	<0.5
	04/24/08			<0.5	22	4	<0.5
	04/08/09			0	<1	4.7	<1
	03/07/13			0	<1	<1	<1
MW-214S	04/14/05	10-13'	---	<1	3	<1	<2
	04/25/06			0,0.5	1	<0.5	<0.5
	04/25/07			<0.5	<0.5	<0.5	<0.5
	04/24/08			<0.5	<0.5	<0.5	<0.5
	03/07/13			<1	<1	<1	<1
	03/21/14			0	<1	<1	<1
	02/21/17			0	<1	<1	<1
<b>SIDE GRADIENT EAST (Vicinity of Aberjona River)</b>							
MW-010S	04/22/02	4-14'	---	<0.1	<0.1	<2	<0.1
	04/14/05			<1	<1	<1	<2
	04/25/06			0,0.5	<0.5	1	<0.5
	04/23/08			<0.5	<0.5	0.7	<0.5
	11/16/11			<0.5	0.25 (J)	0.45 (J)	<1
MW-010M	04/25/02	40-50'	---	<0.1	0.0779 (J)	<2	<0.1
	04/14/05			2	1	<1	<2
	04/25/06			0,0.5	<0.5	<0.5	<0.5
	04/23/08			<0.5	<0.5	<0.5	<0.5
	11/16/11			<0.5	<0.5	<0.5	<1
MW-010D	04/25/02	88.5-98.5'	---	0.174	1.4	<2	<0.1
	04/25/06			<0.5	<0.5	<0.5	<0.5
	11/16/11			<0.5	0.75	0.19 (J)	<1
	04/25/07			0.174	1.4	<2	<0.1
MW-215S (DUP-1)	04/13/05	10-13'	---	2,300	6,200	430	<200
	04/24/06			0,2,400	5,400	250	<100
	04/24/06			2,400	5,200	260	<100
	09/28/06			0,2,900	5,400	290	<50
	04/25/07			0,1,900	3,500	<250	<250
	04/22/08			0,1,400	1,900	120	<10
	11/13/08			3	<50	<50	<50
	12/11/08			2	360	<3	<3
	03/09/09			2	310	<50	<50
	04/08/09			2	190	<50	<50
	11/03/09			3	<50	<50	<50
	02/15/10			2	<50	<50	<50
	03/23/11			3	<5	<5	<5
MW-215SX	03/23/11			3	<25	<25	<25
	10/18/11			3	<10	<10	<10
	10/18/11			3	62	710	120
	11/21/11			<10	<10	<10	<10
MW-215SX	11/21/11			<10	<10	<10	<10
	04/17/12			3	<1	<1	<1
	04/17/12			3	<10	<10	<10
	03/07/13			2	<10	<10	<10
MW-215SX	03/07/13			2	<10	<10	<10
	03/21/14			3	<1	<1	<1
	03/21/14			3	<20	<20	<20
	02/21/17			2	<10	<10	<10

**TABLE 1**  
**SUMMARY OF GROUNDWATER ANALYTICAL DATA - PRIMARY VOCs**  
**60 OLYMPIA AVENUE**  
**WOBBURN, MASSACHUSETTS**

Location Identification	Sampling Date	Screen Interval (feet)	Color	Tetrachloroethene	Trichloroethene	cis-1,2-Dichloroethene	Vinyl Chloride
				Groundwater Standards			
				5	5	70	2
<b>MW-215M</b> MW-215M (DUP-2)	04/13/05	20-23'	---	<1	<1	<1	<2
	04/13/05			<1	<1	<1	<2
	04/26/06			0	<0.5	<0.5	<0.5
	10/30/06			0	<0.5	2	<0.5
	04/24/07			0	<0.5	<0.5	<0.5
	04/22/08			0	<0.5	<0.5	<0.5
	03/23/11			0	<1	100	<1
	10/18/11			0	<1	33	1.5
	08/24/12			0	<1	53	<1
	03/07/13			0	<2	180	2.7
	07/31/13			0	<1	<1	<1
	03/21/14			0	<1	190	51
	10/05/15		4	<10	<10	<10	<10
	02/21/17			0	<1	280	82
	10/26/17			0	<2	200	110
<b>MW-215D</b>	04/13/05	30-33'	---	<1	<1	<1	<2
	09/13/05			0	<0.5	<0.5	<0.5
	01/11/06			0	<0.5	1	<0.5
	04/26/06			0	<0.5	<0.5	<0.5
	07/19/06			0	<0.5	<0.5	<0.5
	03/28/07			0	<0.5	<0.5	<0.5
	04/22/08			0	<0.5	<0.5	<0.5
	02/21/17			0	<1	<1	<1
<b>MW-216S</b>	04/13/05	10-13'	---	<500	20,000	<500	<1,000
	09/13/05			---	740	32,000	<500
	04/26/06			0	<1,000	35,000	<1,000
	09/28/06			0	<1,000	48,000	<1,000
	04/24/07			0	<1,000	48,000	<1,000
	04/22/08			0	<1,000	95,000	<1,000
	12/11/08			0	<500	98,000	<500
	03/09/09			0	<500	40,000	<500
	05/07/09		2	<250	26,000	<250	<250
	11/03/09			0	<500	120,000	<500
	02/15/10			0	180	32,000	<100
	02/15/10		0	<500	78,000	<500	<500
	09/01/10			<130	<25	<25	<25
<b>MW-216SX</b>	09/01/10		4	<1,300	56,000	<250	<250
	03/23/11			0	<1,000	94,000	<1,000
	10/18/11		0	<1,000	26,000	<1,000	<1,000
	04/17/12			<50	17,000	<50	<50
	08/24/12		0	<250	20,000	<250	<250
	03/07/13			2	600	<10	<10
	07/31/13		2	<50	170	<50	<50
	03/21/14			2	<10	270	<10
	05/12/15		1	<10	82	<10	<10
	10/05/15			4	<20	<20	<20
	02/21/17			1	<20	<20	<20
<b>MW-216M</b>	04/13/05	20-23'	---	<1	<1	<1	<2
	04/26/06			0	<0.5	4	<0.5
	04/24/07			0	<0.5	10	<0.5
	04/23/08			0	<0.5	<0.5	<0.5
	03/23/11			0	<0.5	<0.5	<0.5
	03/07/13			0	<1	<1	<1
	07/31/13			0	<1	<1	<1
	03/21/14			0	<1	<1	<1
<b>MW-216D</b>	04/13/05	30-33'	---	<1	<1	<1	<2
	09/13/05			<0.5	<0.5	<0.5	<0.5
	01/11/06			<0.5	<0.5	<0.5	<0.5
	04/26/06			0	<0.5	<0.5	<0.5
	07/19/06			0	<0.5	0.5	<0.5
	12/14/06			0	<0.5	1	<0.5
	04/24/07			0	<0.5	<0.5	<0.5
	04/22/08			0	<0.5	<0.5	<0.5
<b>OUTSIDE CONTAINMENT CELL SIDE GRADIENT WEST (Adjacent to Sewer Line Easement)</b>							
GEO-5	06/24/03	2-12'	---	280	3,300	<50	<50
<b>GEO-6</b>	06/24/03	11-16'	---	<0.5	<0.5	<0.5	<0.5
	04/13/05			<1	<1	<1	<2
	04/24/06			0	<0.5	<0.5	<0.5
	10/30/06			0	<0.5	2	<0.5
	04/24/07			0	<0.5	<0.5	<0.5
	06/18/07			<0.5	<0.5	<0.5	<0.5
<b>GEO-7</b>	06/24/03	6-16'	---	2	8	<0.5	<0.5
	04/13/05			<1	4	<1	<2
	04/24/06			0	1	<0.5	<0.5
	09/28/06			0	2	<0.5	<0.5
	04/26/07			0	<0.5	<0.5	<0.5
	06/18/07			<0.5	<0.5	<0.5	<0.5
<b>MW-13</b>	07/09/02	7-17'	---	410	780	1,500	<2
	04/22/03			650	280	780	<10
	06/02/03			430	250	1,300	<25
	04/14/05			470	160	340	<20
	04/26/06			0	1,500	1,400	<50
	09/28/06			---	1,100	2,200	<25
	04/26/07			---	1,400	4,100	<50
	06/18/07			---	1,100	7,100	380
	11/05/07			---	560	6,400	710
	04/22/08			0	730	6,000	260
<b>MW-13X</b>	04						

**TABLE 1**  
**SUMMARY OF GROUNDWATER ANALYTICAL DATA - PRIMARY VOCs**  
**60 OLYMPIA AVENUE**  
**WOBBURN, MASSACHUSETTS**

Location Identification	Sampling Date	Screen Interval (feet)	Color	Tetrachloroethene	Trichloroethene	cis-1,2-Dichloroethene	Vinyl Chloride
				Groundwater Standards			
				5	5	70	2
<b>MW-212M</b>	04/14/05	20-23'	---	<1	<1	<1	<2
	04/26/06			0	<0.5	3	<0.5
	04/25/07			0	<0.5	7	<0.5
	03/07/13			0	<1	<1	<1
	03/21/14			0	<1	<1	<1
	02/21/17			0	<1	<1	<1
<b>MW-212D</b> MW-212D (DUP-6)	04/14/05	30-33'	---	<1	<1	<1	<2
	04/14/05			---	<1	<1	<2
	04/26/06			0	<0.5	<0.5	<0.5
	04/26/07			0	<0.5	<0.5	<0.5
	04/08/09			0	<0.5	<0.5	<0.5
	02/21/17			0	<1	1	<1
<b>MW-213S</b> MW-213S (DUP-1)	04/13/05	10-13'	---	240	70	140	<10
	04/13/05			230	70	140	<10
	04/24/06			0	120	47	<25
	03/28/07			0	330	150	<10
	06/18/07			---	400	200	<10
	04/22/08			0	280	110	<25
	04/08/09			0	400	81	<50
	09/01/10			2	210	<25	<25
	09/01/10			2	640	120	<25
	03/23/11			0	140	51	<25
	03/23/11			0	140	50	<10
	03/23/11			0	150	53	<25
	10/18/11			0	72	140	<40
	10/18/11			0	<10	<10	<10
<b>MW-213 ASCORBIC ACID</b>	04/17/12			0	88	36	<10
	04/17/12			0	82	34	<5
	08/24/12		3	120	1,400	36	<20
	08/24/12			<5	<5	<5	<5
	03/07/13		1	15	59	<10	<10
	03/07/13		1	<10	<10	<10	<10
	07/31/13		2	<20	<20	<20	<20
	03/21/14		0	<10	18	<10	<10
	03/21/14		0	<10	17	<10	<10
	10/05/15		0	16	47	190	<10
<b>MW-213SX</b>	02/21/17		0	<25	270	98	<25
	10/26/17		0	<10	170	240	<10
	03/23/18		0	9.8	260	<5	<5
	04/13/05	20-23'	---	<1	<1	<1	<2
	04/24/06			<0.5	<0.5	<0.5	<0.5
	04/24/07			0	<0.5	<0.5	<0.5
	06/18/07			0	<0.5	<0.5	<0.5
	03/23/11			0	6	3	<0.5
	10/18/11			0	1.9	1.2	<1
	03/07/13			0	3.6	2.4	<1
	07/31/13			0	4.2	3.8	<1
	03/21/14			0	2.6	1.5	<1
	02/21/17			0	6.2	11	<1
<b>MW-213D</b>	04/13/05	30-33'	---	<1	<1	<1	<2
	04/24/06			0	<0.5	<0.5	<0.5
	03/28/07			0	<0.5	<0.5	<0.5
	02/21/17			0	<1	<1	<1
<b>MW-220M</b>	04/14/05	20-23'	---	<1	<1	<1	<2
	04/26/06			0	<1	<1	<1
	04/27/07			0	<0.5	<0.5	<0.5
	02/21/17			0	<1	6.9	<1
<b>MW-220D</b>	04/13/05	30-33'	---	<1	<1	<1	<2
	04/26/06			0	<0.5	<0.5	<0.5
	09/28/06			0	<0.5	<0.5	<0.5
	04/26/07			0	<0.5	<0.5	<0.5
	02/21/17			0	<1	<1	<1
<b>SIDE GRADIENT WEST (Adjacent to Sewer Line Easement)</b>							
GEO-8 (MW-301)	06/18/07	15-20'	---	<0.5	<0.5	<0.5	<0.5
	04/23/08		0	<0.5	<0.5	<0.5	<0.5
GEO-9 (MW-302)	06/18/07	15-20'	---	<0.5	<0.5	<0.5	<0.5
	04/24/08		0	<0.5	<0.5	<0.5	<0.5
<b>DOWNGRADIENT</b>							
<b>MW-011S</b>	04/26/02	4-14'	---	<0.1	0.13	<2	0.264
	04/14/05			2	5	13	<2
	04/25/06			3	8	26	2
	04/23/08			0.5	2	12	1
	11/16/11			<0.5	2.1	4.7	1.2
	03/23/18			<1	1.4	4.4	<1
<b>MW-011M</b>	04/26/02	40-50'	---	7	120	17	<2
	04/14/05			<1	19	2	<2
	04/25/06			<0.5	4	0.8	<0.5
	04/23/08			<0.5	2	0.6	<0.5
	11/16/11			<0.5	0.80	0.30 (J)	<1
	03/23/18			<1	<1	<1	<1
<b>MW-011D</b>	04/26/02	81-91'	---	<0.1	<0.1	<2	<0.1
	04/25/06			<0.5	<0.5	<0.5	<0.5
	04/23/08			<0.5	<0.5	<0.5	<0.5
	11/16/11			<0.5	<0.5	<0.5	<1
<b>MW-014S</b>	07/10/02	5-15'	---	25	180	670	190
	04/22/03			1	6	61	19
	06/02/03			2	15	62	16
	04/13/05			3	6	98	16
	09/28/06		1	120	810	110	<10
	04/24/07						

**TABLE 1**  
**SUMMARY OF GROUNDWATER ANALYTICAL DATA - PRIMARY VOCs**  
**60 OLYMPIA AVENUE**  
**WOBBURN, MASSACHUSETTS**

Location Identification	Sampling Date	Screen Interval (feet)	Color	Tetrachloroethene	Trichloroethene	cis-1,2-Dichloroethene	Vinyl Chloride
				Groundwater Standards			
				5	5	70	2
<b>MW-014M</b>	07/10/02	20-30'	---	<0.1	<0.1	<2	<0.1
	04/13/05			<1	<1	<1	<2
	04/24/06			0	<0.5	<0.5	<0.5
	10/30/06			0	<0.5	<0.5	<0.5
	04/24/07			0	<0.5	<0.5	<0.5
	03/07/13			0	<1	<1	<1
	03/21/14			0	<1	<1	<1
<b>MW-014D</b> MW-014D (DUP4)	04/13/05	37-40'	---	<1	<1	<1	<2
	04/13/05			<1	<1	<1	<2
	04/25/06			0	<0.5	<b>0.6</b>	<0.5
	12/14/06			0	<0.5	<b>0.5</b>	<0.5
	04/24/07			0	<0.5	<b>2</b>	<0.5
	04/24/08			0	<0.5	<0.5	<0.5
	04/07/09			0	<0.5	<0.5	<0.5
	03/07/13			0	<1	<1	<1
	03/21/14			0	<1	<1	<1
<b>MW-217S</b> MW-217S (DUP-1) MW-217S (DUP-1)	04/13/05	10-13'	---	<5	<b>190</b>	<b>400</b>	<10
	04/24/06			0	<b>7</b>	<b>80</b>	<5
	04/24/07			0	<0.5	<b>3</b>	<0.5
	04/22/08			0	<b>12</b>	<b>83</b>	<5
	04/22/08			0	<b>12</b>	<b>88</b>	<5
	04/08/09			0	<b>5</b>	<b>190</b>	<5
	04/08/09			0	<5	<b>170</b>	<5
	09/01/10			0	<130	<b>840</b>	<b>2,200</b>
	03/23/11			0	<b>0.8</b>	<b>31</b>	<b>2</b>
	10/18/11			0	<1	<b>5.4</b>	<1
	03/07/13			0	<1	<b>2.4</b>	<1
	03/21/14			0	<1	<1	<1
	02/21/17			0	<1	<1	<1
<b>MW-217M</b> MW-217MX MW-217MX MW-217M ASCORBIC ACID MW-217M HCL MW-217MX DUP-1 MW-217MX MW-217M-DUP	04/13/05			<1	<1	<1	<2
	04/24/06			0	<0.5	<0.5	<0.5
	04/24/07			0	<0.5	<0.5	<0.5
	04/23/08		<b>2</b>	<25	<25	<25	<25
	04/08/09			2	<0.5	<0.5	<0.5
	03/23/11		<b>0</b>	<0.5	<b>25</b>	<b>19</b>	<0.5
	03/23/11			0	<b>26</b>	<b>20</b>	<0.5
	10/18/11		<b>0</b>	<1	<b>110</b>	<b>100</b>	<b>1.7</b>
	10/18/11			0	<b>110</b>	<b>100</b>	<b>1.9</b>
	04/17/12		<b>---</b>	<5	<b>420</b>	<b>320</b>	<b>10</b>
	04/17/12			---	<b>400</b>	<b>320</b>	<b>10</b>
	08/24/12		<b>0</b>	<10	<b>610</b>	<b>500</b>	<b>16</b>
	03/07/13			0	<b>590</b>	<b>470</b>	<b>16</b>
	03/07/13		<b>0</b>	<10	<b>780</b>	<b>670</b>	<b>25</b>
	03/07/13			0	<b>540</b>	<b>440</b>	<b>17</b>
	07/31/13		<b>0</b>	<20	<b>580</b>	<b>460</b>	<20
	03/21/14			0	<b>1,200</b>	<b>690</b>	<b>32</b>
	03/21/14		<b>0</b>	<10	<b>1,600</b>	<b>530</b>	<b>34</b>
	09/29/14			0	<b>1,500</b>	<b>490</b>	<b>28</b>
	05/12/15		<b>2</b>	<10	<b>1,400</b>	<b>490</b>	<b>30</b>
	10/05/15			4.2	<b>260</b>	<b>23</b>	<2
	04/13/16		<b>---</b>	<50	<b>4,000</b>	<b>430</b>	<50
	08/10/16			3	<b>6.1</b>	<b>220</b>	<2
	08/25/16		<b>3</b>	<25	<b>4,500</b>	<b>380</b>	<100
	10/18/16			0	<b>680</b>	<b>14</b>	<2.5
	02/21/17		<b>1</b>	<50	<b>1,300</b>	<b>31</b>	<25
	05/10/17			2	<b>1,500</b>	<b>98</b>	<20
	06/29/17		<b>1</b>	<2,600	<b>7,800</b>	<b>610</b>	<50
	07/27/17			1	<b>320,000</b>	<b>140</b>	<25
	10/26/17		<b>0</b>	<20	<b>320,000</b>	<b>27,000</b>	<2,600
	02/27/18			0	<b>4,800</b>	<b>27,000</b>	<20
	03/23/18		<b>0</b>	<50	<b>5,000</b>	<b>380</b>	<50
	06/22/18			0	<b>57</b>	<b>7,700</b>	<b>960</b>
	06/22/18		<b>0</b>	<50	<b>6,200</b>	<b>590</b>	<50
	06/22/18			0	<b>5,700</b>	<b>580</b>	<50
<b>MW-217D</b>	04/13/05	37-40'	---	<1	<1	<1	<2
	09/13/05			0	<0.5	<0.5	<0.5
	01/11/06			0	<0.5	<0.5	<0.5
	04/24/06			0	<0.5	<0.5	<0.5
	07/19/06			0	<0.5	<0.5	<0.5
	03/28/07			0	<0.5	<0.5	<0.5
	03/21/14			0	<1	<1	<1
	02/21/17			0	<1	<1	<1
<b>MW-218S</b> MW-218S (DUP-2)	04/13/05	10-13'	---	<1	<b>27</b>	<b>93</b>	<b>5</b>
	04/25/06			0	<b>1</b>	<b>44</b>	<b>6</b>
	04/25/06			0	<b>1</b>	<b>45</b>	<b>6</b>
	04/25/07			0	<b>3</b>	<b>10</b>	<b>3</b>
	04/23/08			0	<b>4</b>	<b>9</b>	<b>3</b>
	04/08/09			0	<b>0.5</b>	<b>1</b>	<0.5
	03/21/14			0	<1	<b>1.6</b>	<1
	02/21/17			0	<1	<b>1.2</b>	<1
<b>MW-218M</b>	04/13/05	25-28'	---	<1	<1	<1	<2
	04/26/06			0	<0.5	<b>4</b>	<0.5
	04/25						

**TABLE 1**  
**SUMMARY OF GROUNDWATER ANALYTICAL DATA - PRIMARY VOCs**  
**60 OLYMPIA AVENUE**  
**WOBURN, MASSACHUSETTS**

Location Identification	Sampling Date	Screen Interval (feet)	Color	Tetrachloroethene	Trichloroethene	cis-1,2-Dichloroethene	Vinyl Chloride
				Groundwater Standards			
				5	5	70	2
MW-219S	04/13/05	10-13'	---	<1	2	33	5
	04/25/06			0	<0.5	<0.5	<0.5
	04/25/07			0	<0.5	<0.5	<0.5
	04/23/08			0	<0.5	<0.5	<0.5
	04/07/09			0	<0.5	<0.5	<0.5
	03/07/13			0	<1	<1	<1
	03/21/14			0	<1	<1	<1
	02/21/17			0	<1	1.6	2.8
MW-219M	04/13/05	25-28'	---	<1	6	63	12
	04/25/06			0	11	210	12
	04/24/07			0	6	56	6
	04/23/08			0	1	39	8
	04/08/09			0	0.7	16	3
	03/07/13			0	<1	7.9	1.8
	03/21/14			0	<1	9.5	2.3
	02/21/17			0	<1	<1	<1
MW-219D	04/13/05	37-40'	---	<1	<1	<1	<2
	09/13/05			---	<0.5	<0.5	<0.5
	01/11/06			0	<0.5	<0.5	<0.5
	04/25/06			0	<0.5	<0.5	<0.5
	07/19/06			0	<0.5	<0.5	<0.5
	03/28/07			0	<0.5	<.5	<0.5
	04/24/07			0	<0.5	<0.5	<0.5
	02/21/17			0	<1	<1	<1

**NOTES:**

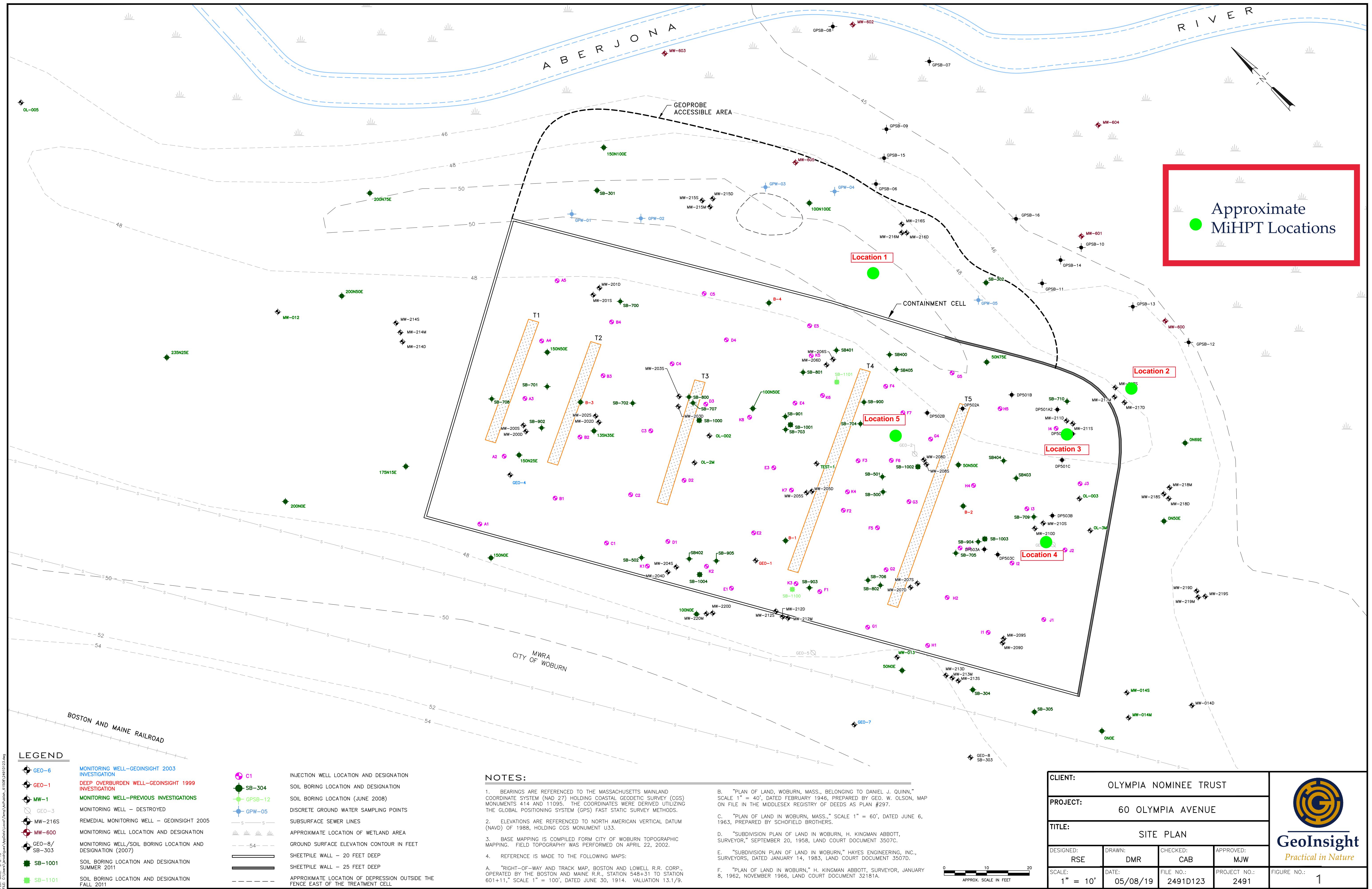
1. Values in micrograms per liter ( $\mu\text{g/L}$ ).
2. Bold exceeds laboratory detection limits.
3. Shaded concentrations exceed applicable Groundwater Standard.
4. Groundwater Standards are ROD ICLs or MCP Method 1/GW-1 Risk Standards.
5. (J) = estimated concentration.
6. (U) = estimated non-detect.
7. ND = Not Detected: detection limit unknown.
8. --- = Not analyzed
9. Sodium permanganate injected between September 1, 2005 and November 16, 2018.
10. D = listed value obtained from second (diluted) analytical run.
11. c = Concentration exceeded calibration range for the analyte.
12. On March 28, 2007 OL-2M was mislabeled as MW-OL-2M on the chain of custody submitted to the lab.

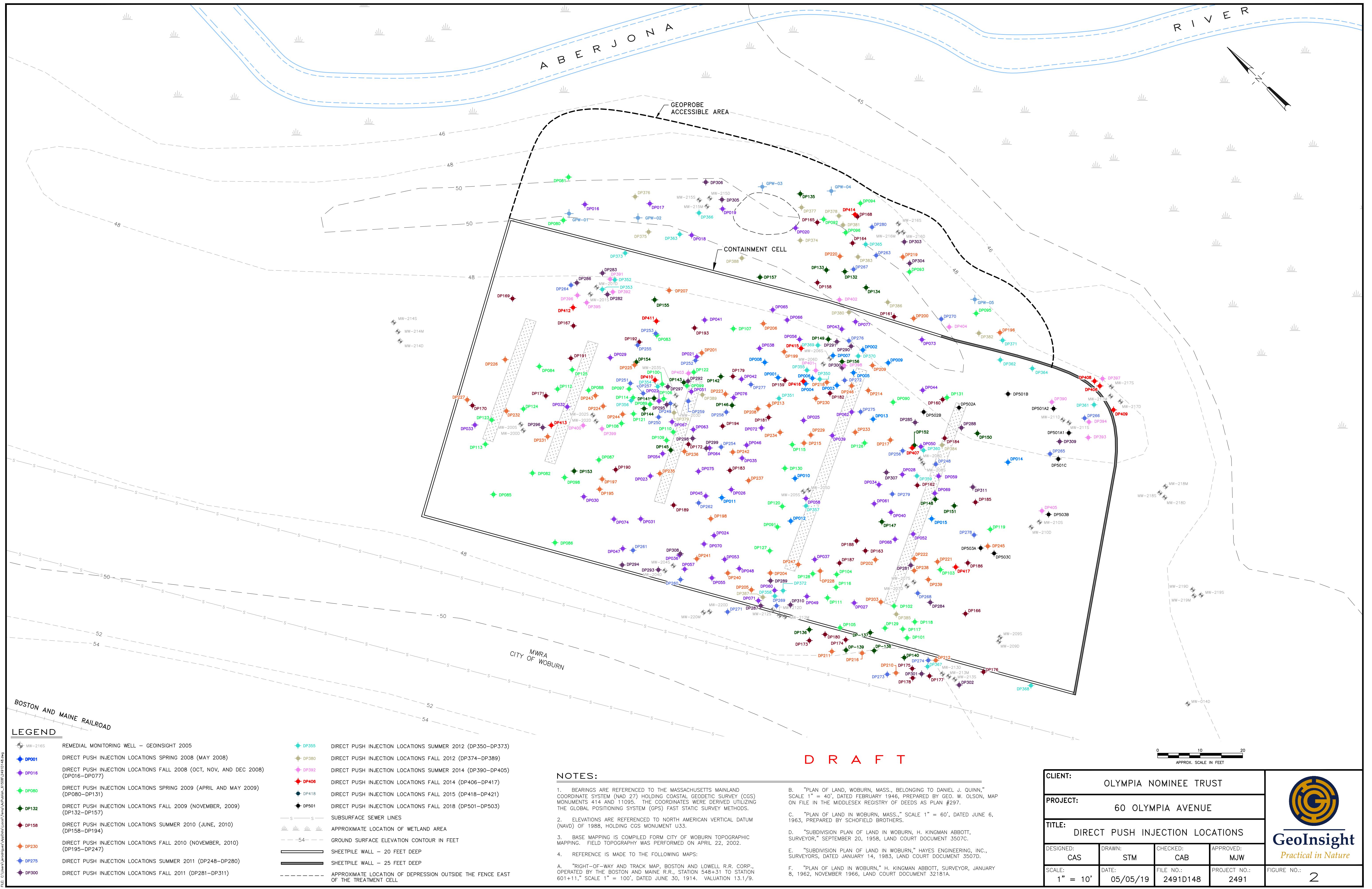
**TABLE 2**  
**SUMMARY OF SODIUM PERMANGANATE INJECTION EVENTS**  
**60 OLYMPIA AVENUE**  
**WOBURN, MASSACHUSETTS**

Event	Method	Approximate Strength (Percent Solution)	Volume (Gallons)						TOTAL
			Trenches	Injection Wells	DPs	East Side DPs	SW Corner DPs	MW Wells	
<b>2005</b>	<b>Gravity</b>	<b>40%</b>							<b>8,464</b>
September 1	Trenches	40%	1,059	---	---	---	---	---	1,059
September 15	Trenches	40%	1,077	---	---	---	---	---	1,077
September 29	Injection Wells	40%	244	914	---	---	---	---	1,158
October 13	Trenches	40%	1,093	---	---	---	---	---	1,093
November 3	Injection Wells	40%	26	975	---	---	---	---	1,001
November 10	Trenches	40%	1,010	---	---	---	---	---	1,010
November 22	Injection Wells	40%	62	906	---	---	---	---	968
December 16	Injection Wells and Trenches	40%	401	698	---	---	---	---	1,099
<b>2007</b>	<b>Pressure and Gravity</b>	<b>10 to 20%</b>							<b>580</b>
September 6	K-Series Injection Wells	10 to 20%	---	384	---	---	---	---	384
September 6	Injection Wells	20%	---	196	---	---	---	---	196
<b>2008</b>	<b>Direct Push and Gravity</b>	<b>1 to 5%</b>							<b>16,413</b>
May 20 to 22	Direct Push (DP) Locations, Injection Wells, and Trenches	5%	330	609	2,338	---	---	---	3,277
October 13 and 15	Direct Push Locations East of Treatment Cell	1%	---	---	---	970	---	---	970
October 15 to 17	Direct Push Locations, Injection Wells, and Trenches	2 to 4%	913	21	1,832	---	---	---	2,766
November 10 to 14	Direct Push Locations, Injection Wells, and Trenches	2 to 3%	412	85	4,472	---	---	---	4,969
December 8 to 11	Direct Push Locations and Trenches	2 to 3%	351	---	4,080	---	---	---	4,431
<b>2009</b>	<b>Direct Push and Gravity</b>	<b>0.5 to 3%</b>							<b>13,432</b>
April 21 to 23	Direct Push Locations and Trenches	2 to 3%	102	---	2,496	1,614	---	---	4,212
May 19 to 22	Direct Push Locations, Injection Wells, and Trenches	2 to 3%	612	37	4,110	---	---	---	4,759
June 24	Injection Wells and Trenches	0.5 to 3%	240	45	---	---	---	---	285
November 16 to 20 and 23	Direct Push Locations, Injection Wells, and Trenches	2 to 3%	124	65	2,042	1,296	649	---	4,176
<b>2010</b>	<b>Direct Push and Gravity</b>	<b>0.5 to 1%</b>							<b>34,326</b>
June 7 to 11	Direct Push Locations, Injection Wells, and Trenches	0.5 to 1%	4,410	576	3,940	2,235	1,763	---	12,924
July 29	Injection Wells and Trenches	0.5%	150	---	---	---	---	---	150
November 1 to 5 and 8 to 10	Direct Push Locations, Injection Wells, and Trenches	0.5%	9,128	10	7,368	2,620	2,126	---	21,252
<b>2011</b>	<b>Direct Push and Gravity</b>	<b>0.5 to 1%</b>							<b>39,396</b>
June 13 to 17, 20, and 21	Direct Push Locations, Injection Wells, and Trenches	0.5 to 1%	8,917	191	6,860	2,511	2,156	---	20,635
November 15 to 18, 21 and 22	Direct Push Locations, Injection Wells, and Trenches	0.5 to 1%	8,380	20	7,827	1,507	1,027	---	18,761
<b>2012</b>	<b>Direct Push and Gravity</b>	<b>1%</b>							<b>27,571</b>
June 25 to 29 and July 2 and 3	Direct Push Locations, Injection Wells, and Trenches	1%	835	5,631	5,196	3,305	1,302	---	16,269
November 12 to 16	Direct Push Locations, Injection Wells, and Trenches	1%	3,880	365	1,149	5,908	---	---	11,302
<b>2013</b>	<b>Direct Push and Gravity</b>	<b>1%</b>							<b>9,512</b>
November 18 to 23	Direct Push Locations, Injection Wells, and Trenches	1%	5,367	1,112	2,330	703	---	---	9,512
<b>2014</b>	<b>Direct Push and Gravity</b>	<b>5%</b>							<b>11,845</b>
July 11 and 15	Monitoring Wells, Injection Wells, and Trenches	5%	20	17	---	---	---	233	270
November 10 to 13	Direct Push Locations, Injection Wells, and Trenches	1%	5,705	26	4,100	1,744	---	---	11,575
<b>2015</b>	<b>Direct Push and Gravity</b>	<b>2% to 20%</b>							<b>916</b>
July 14 and 15	Monitoring Wells and Injection Wells	4% to 20%	---	65	---	---	---	101	166
November 16 to 18	Direct Push Locations, Injection Wells and Trenches	2% to 4%	60	390	300	---	---	---	750
<b>2016</b>	<b>Direct Push and Gravity</b>	<b>2% to 4%</b>							<b>1,265</b>
July 20 to 21	Injection Wells	2% to 4%	45	350	---	---	---	---	395
December 14 to 15	Injection Wells, Shallow Auger Holes and Trenches	2% to 4%	120	450	300	---	---	---	870
<b>2017</b>	<b>Direct Push and Gravity</b>	<b>1% to 5%</b>							<b>2,985</b>
April 18 to 19	Injection Wells	1% to 5%	100	1,110	---	---	---	---	1,210
August 30 to 31	Injection Wells	4%	100	600	---	---	---	---	700
November 28 to 29	Injection Wells, Shallow Auger Holes and Trenches	2% to 5%	100	975	---	---	---	---	1,075
<b>2018</b>	<b>Direct Push</b>	<b>2% to 4%</b>							<b>4,240</b>
November 15 to 16	Direct Push Locations	2% to 4%	1,000	---	3,240	---	---	---	4,240
<b>TOTALS</b>			<b>56,373</b>	<b>16,822</b>	<b>63,980</b>	<b>24,413</b>	<b>9,023</b>	<b>334</b>	<b>170,945</b>



## FIGURES





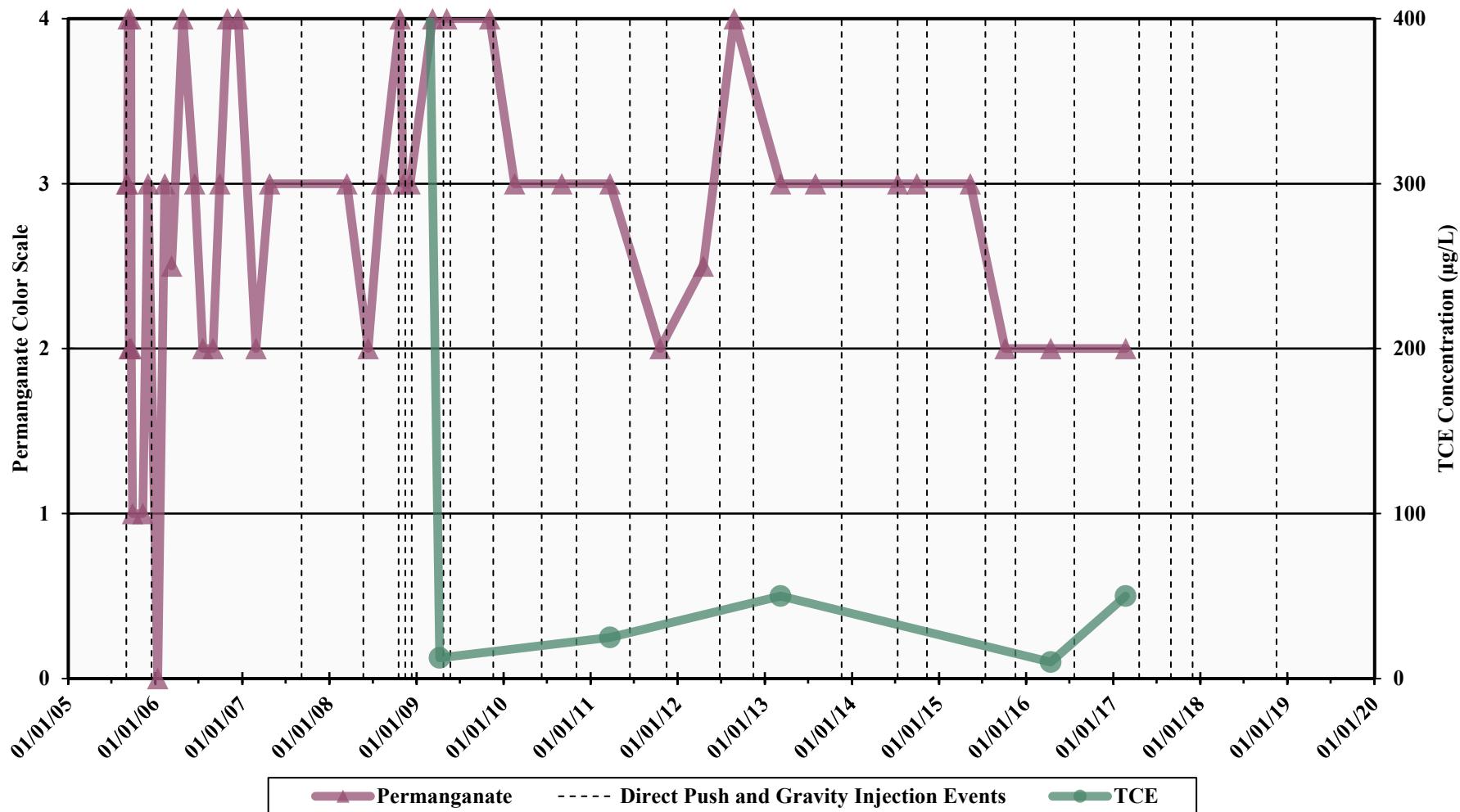


**ATTACHMENT**



**ATTACHMENT A**

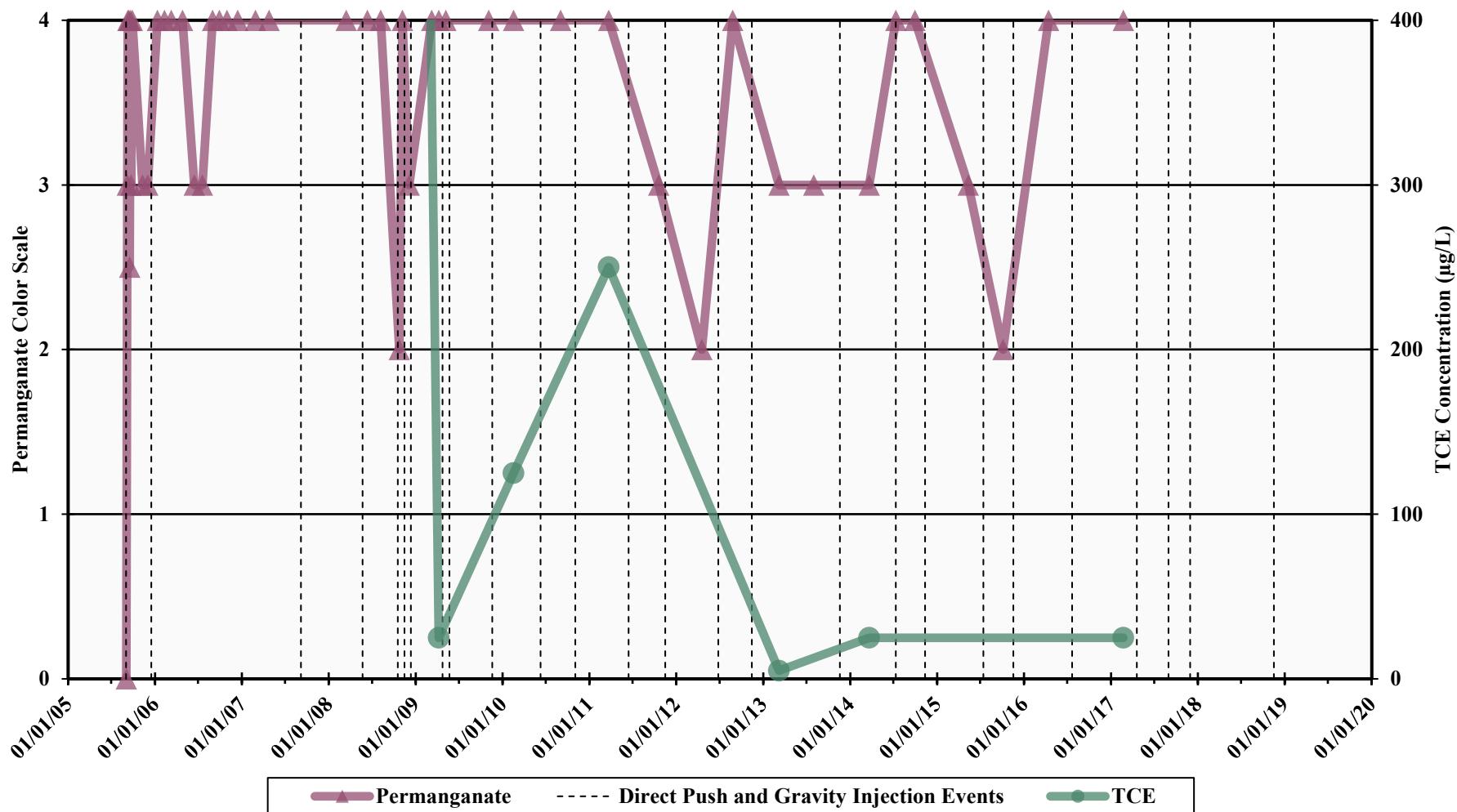
**WELL MW-200S**  
**SODIUM PERMANGANATE AND TCE CONCENTRATIONS VS. TIME**



**NOTES:**

1. TCE = trichloroethylene.
2. µg/L = micrograms per liter.

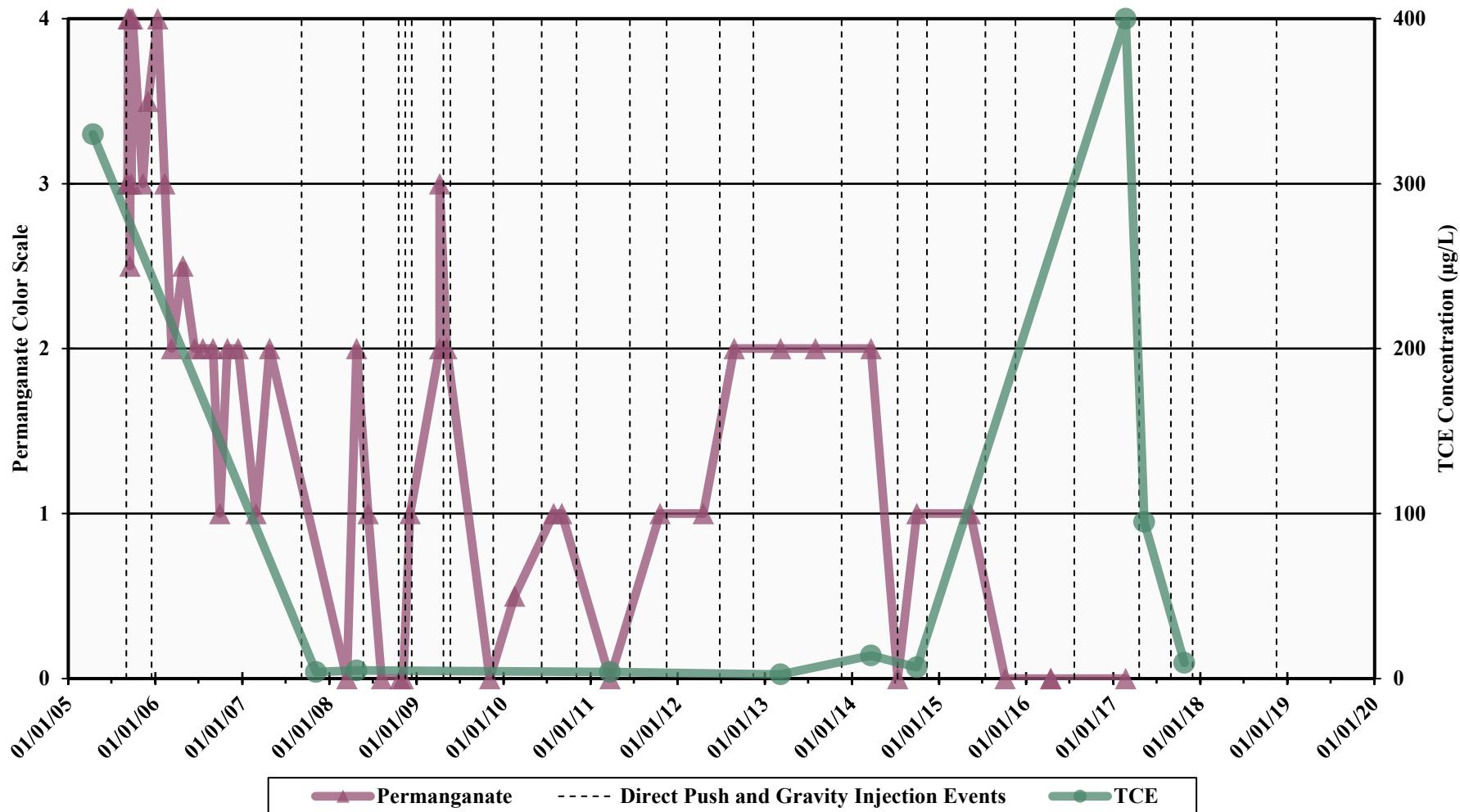
**WELL MW-200D**  
**SODIUM PERMANGANATE AND TCE CONCENTRATIONS VS. TIME**



**NOTES:**

1. TCE = trichloroethylene.
2.  $\mu\text{g/L}$  = micrograms per liter.

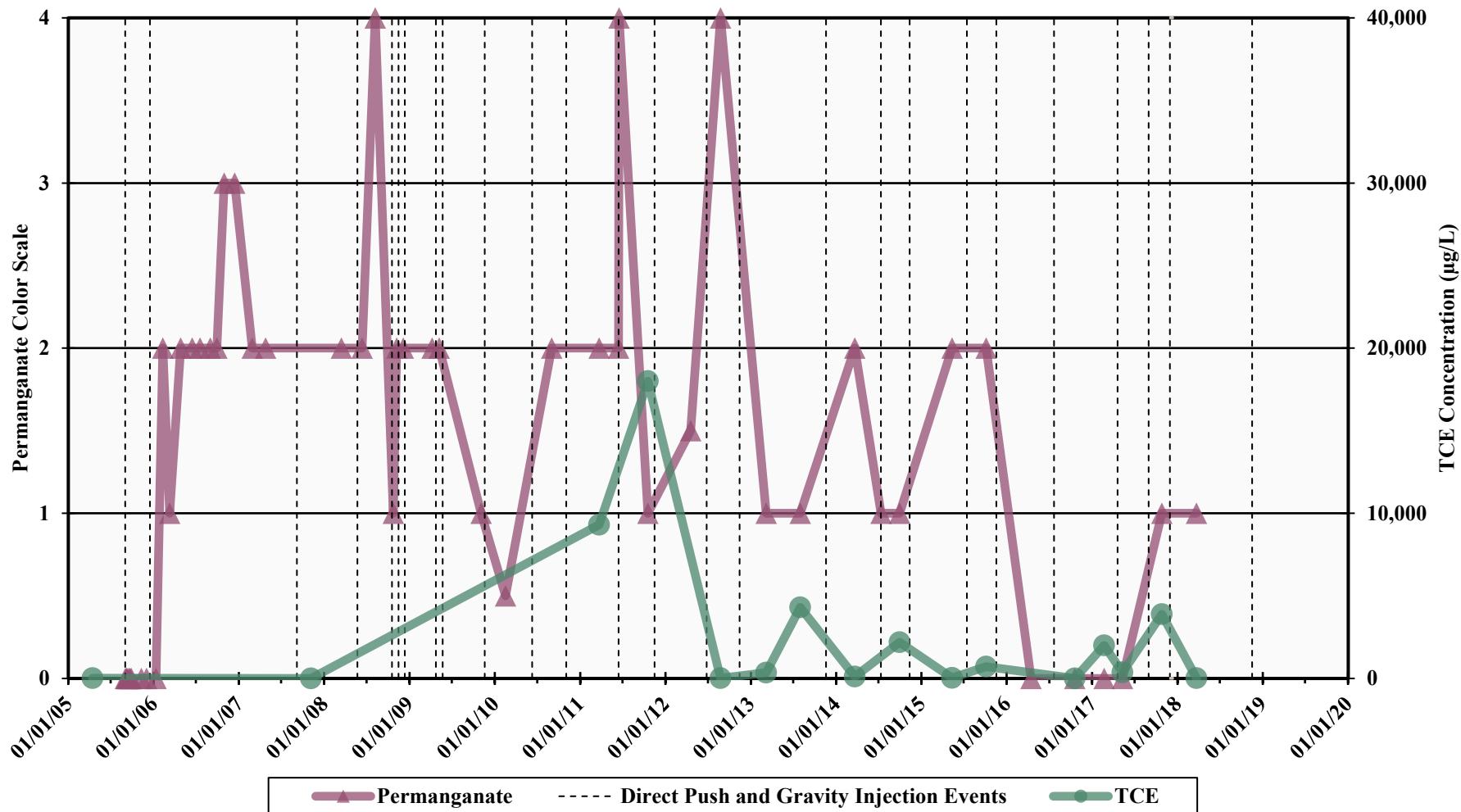
**WELL MW-201S**  
**SODIUM PERMANGANATE AND TCE CONCENTRATIONS VS. TIME**



**NOTES:**

1. TCE = trichloroethylene.
2. µg/L = micrograms per liter.

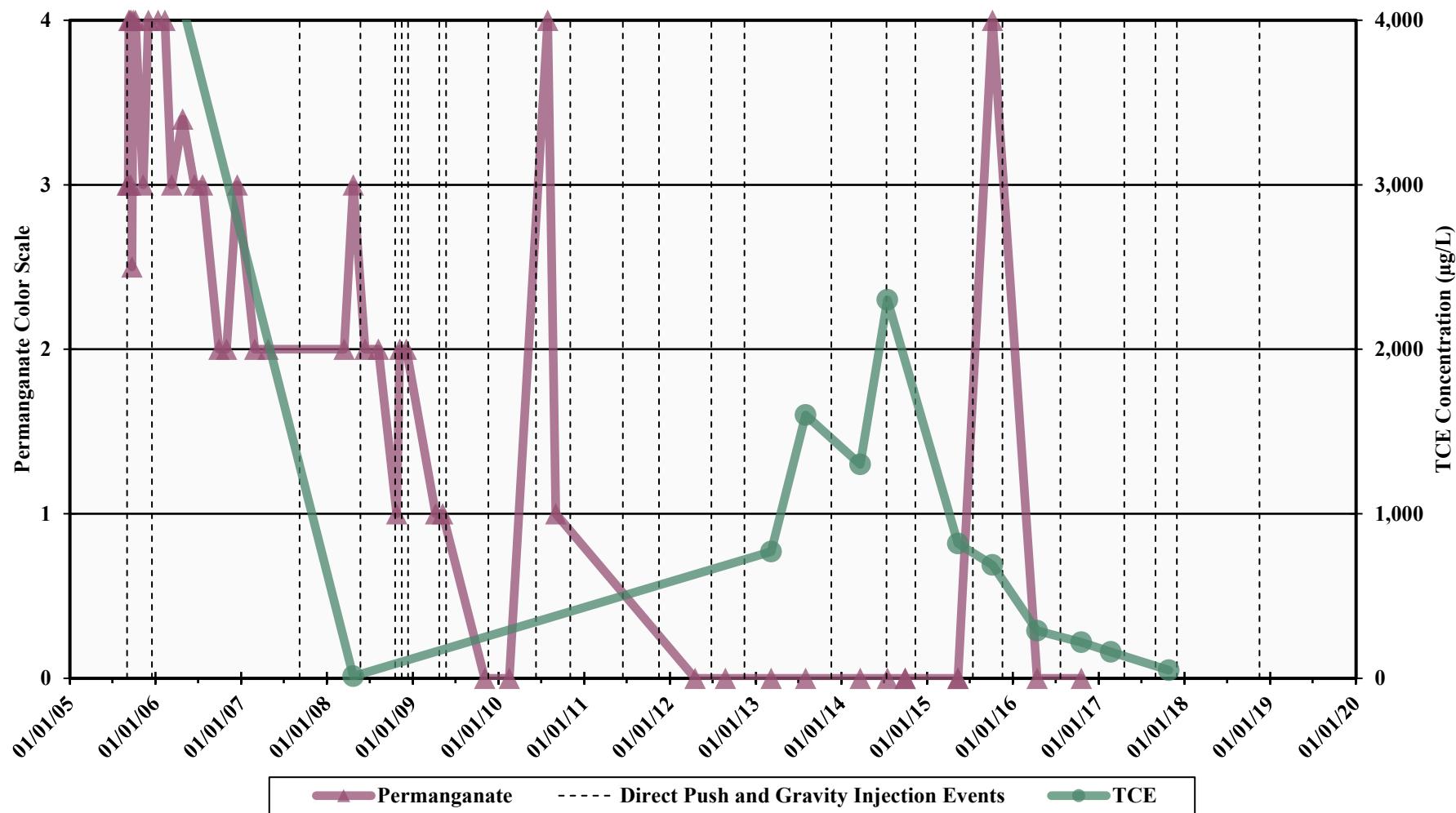
**WELL MW-201D**  
**SODIUM PERMANGANATE AND TCE CONCENTRATIONS VS. TIME**



**NOTES:**

1. TCE = trichloroethylene.
2. µg/L = micrograms per liter.

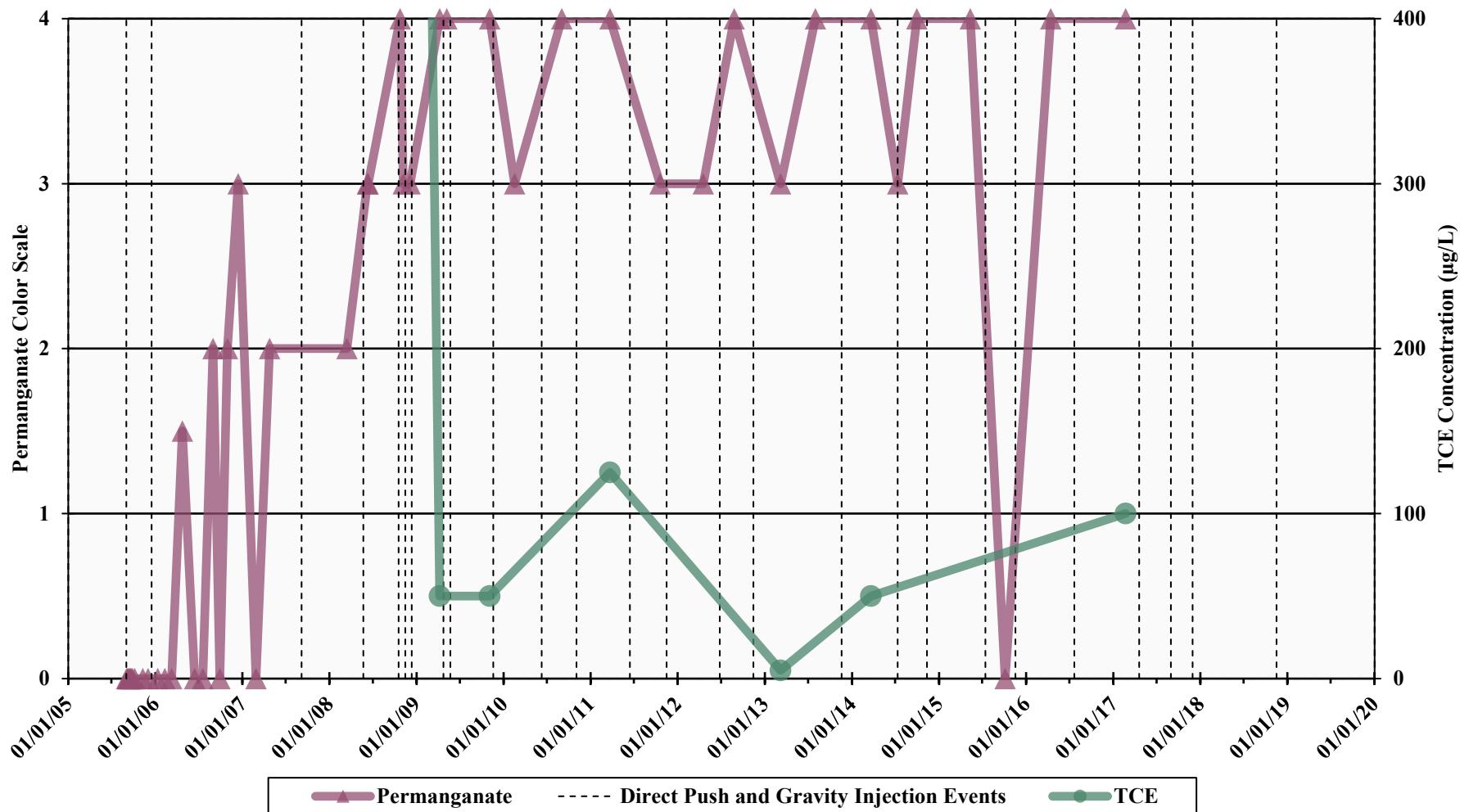
**WELL MW-202S**  
**SODIUM PERMANGANATE AND TCE CONCENTRATIONS VS. TIME**



**NOTES:**

1. TCE = trichloroethylene.
2. µg/L = micrograms per liter.

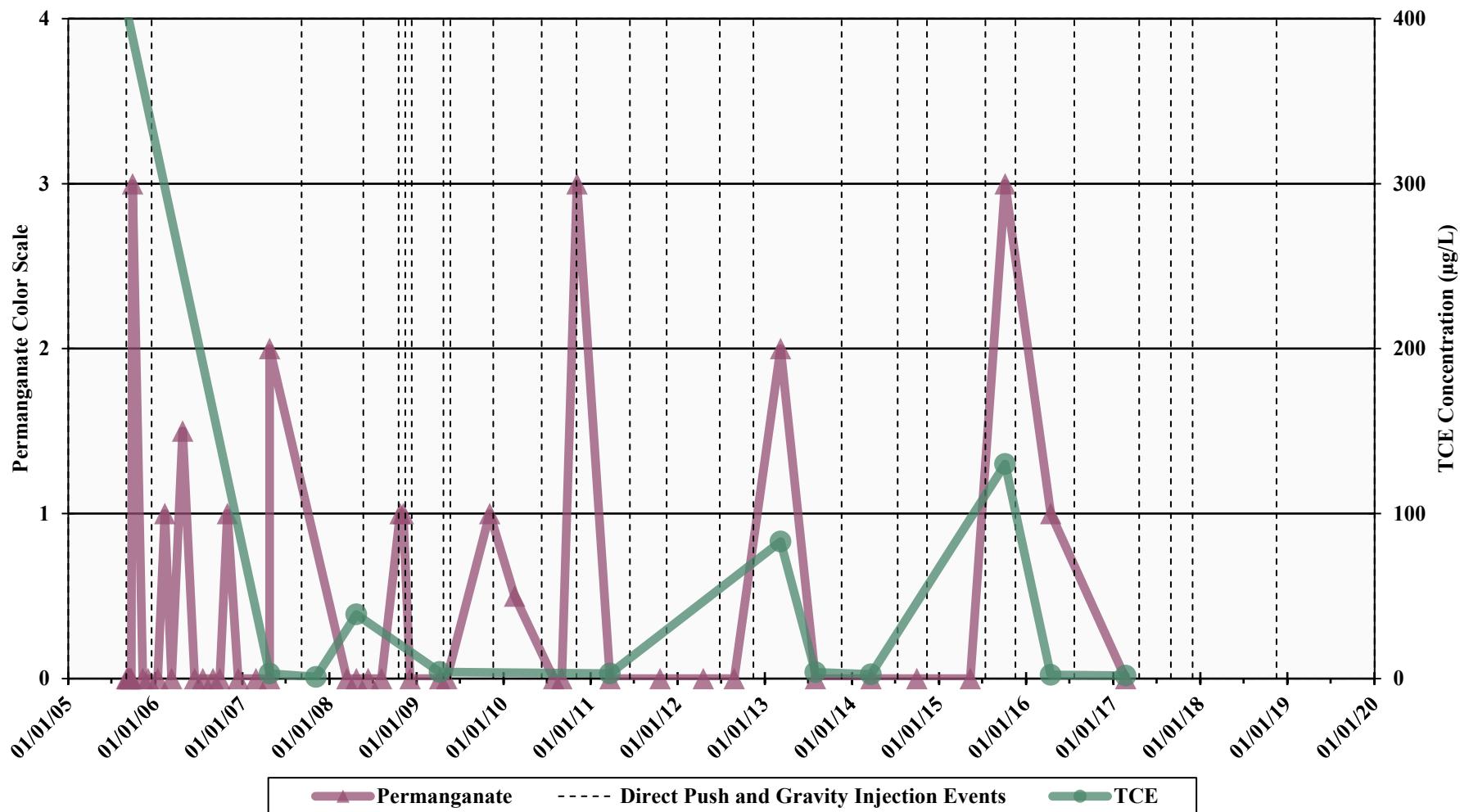
**WELL MW-202D**  
**SODIUM PERMANGANATE AND TCE CONCENTRATIONS VS. TIME**



**NOTES:**

1. TCE = trichloroethylene.
2.  $\mu\text{g/L}$  = micrograms per liter.

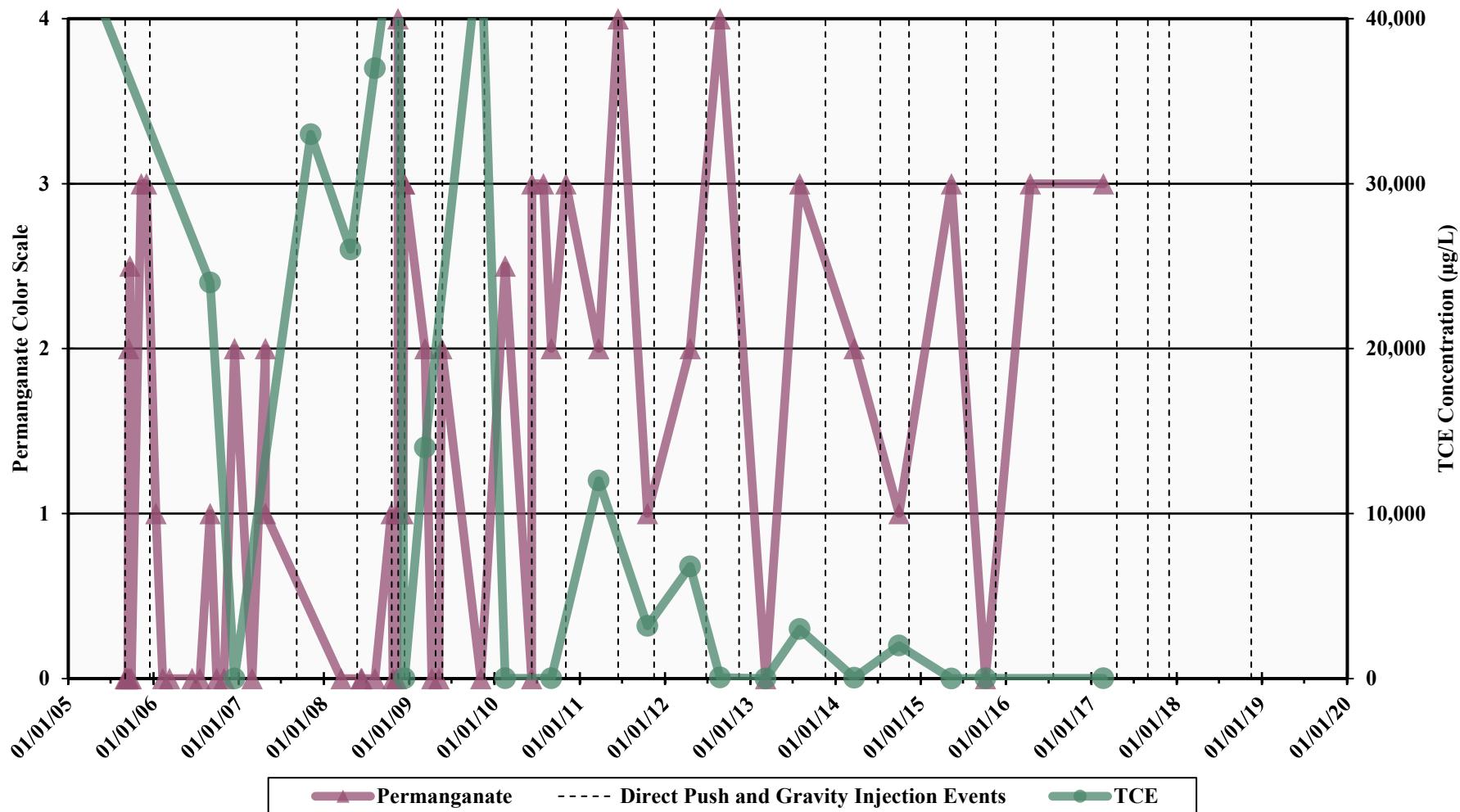
**WELL MW-203S**  
**SODIUM PERMANGANATE AND TCE CONCENTRATIONS VS. TIME**



**NOTES:**

1. TCE = trichloroethylene.
2. µg/L = micrograms per liter.

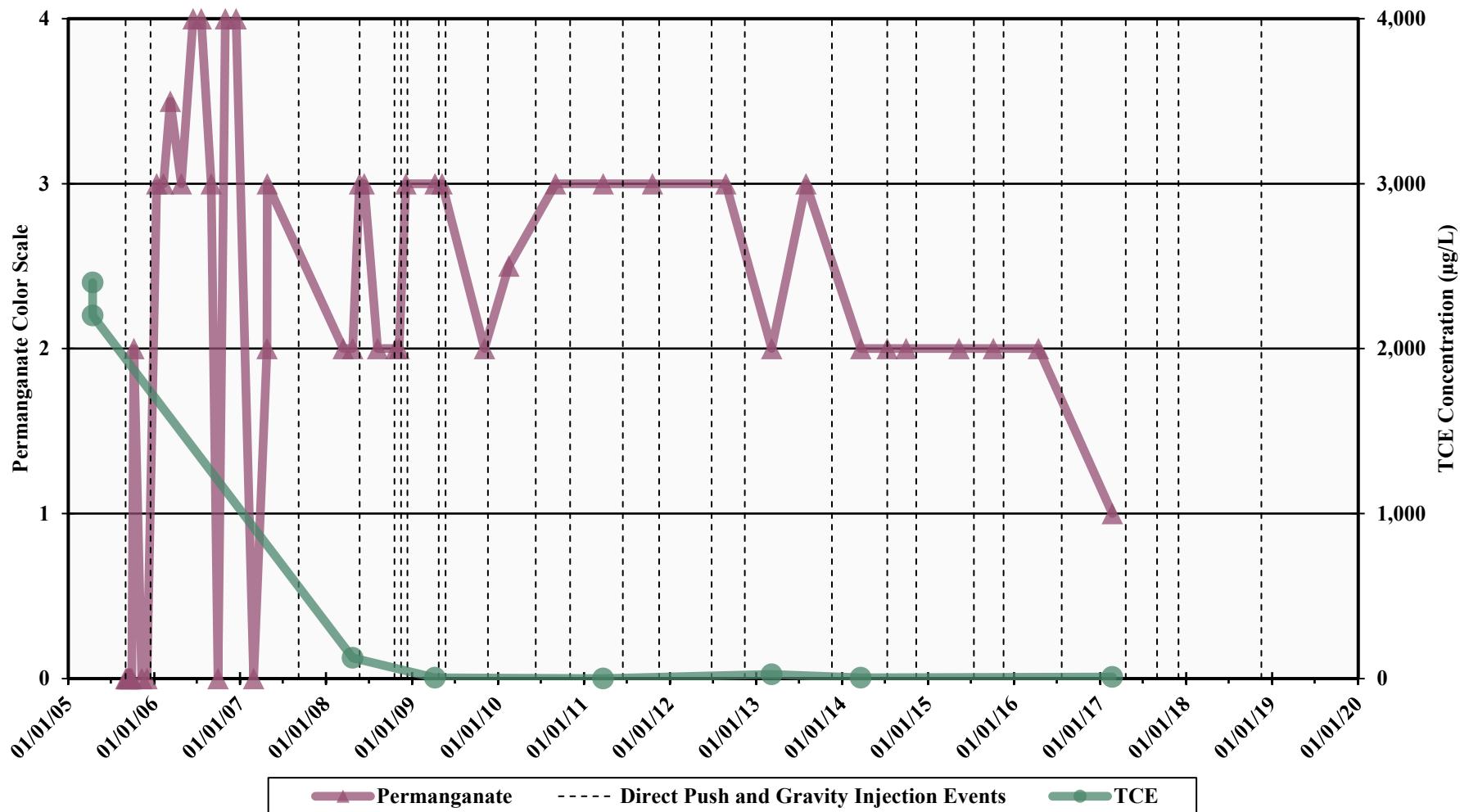
**WELL MW-203D**  
**SODIUM PERMANGANATE AND TCE CONCENTRATIONS VS. TIME**



**NOTES:**

1. TCE = trichloroethylene.
2. µg/L = micrograms per liter.

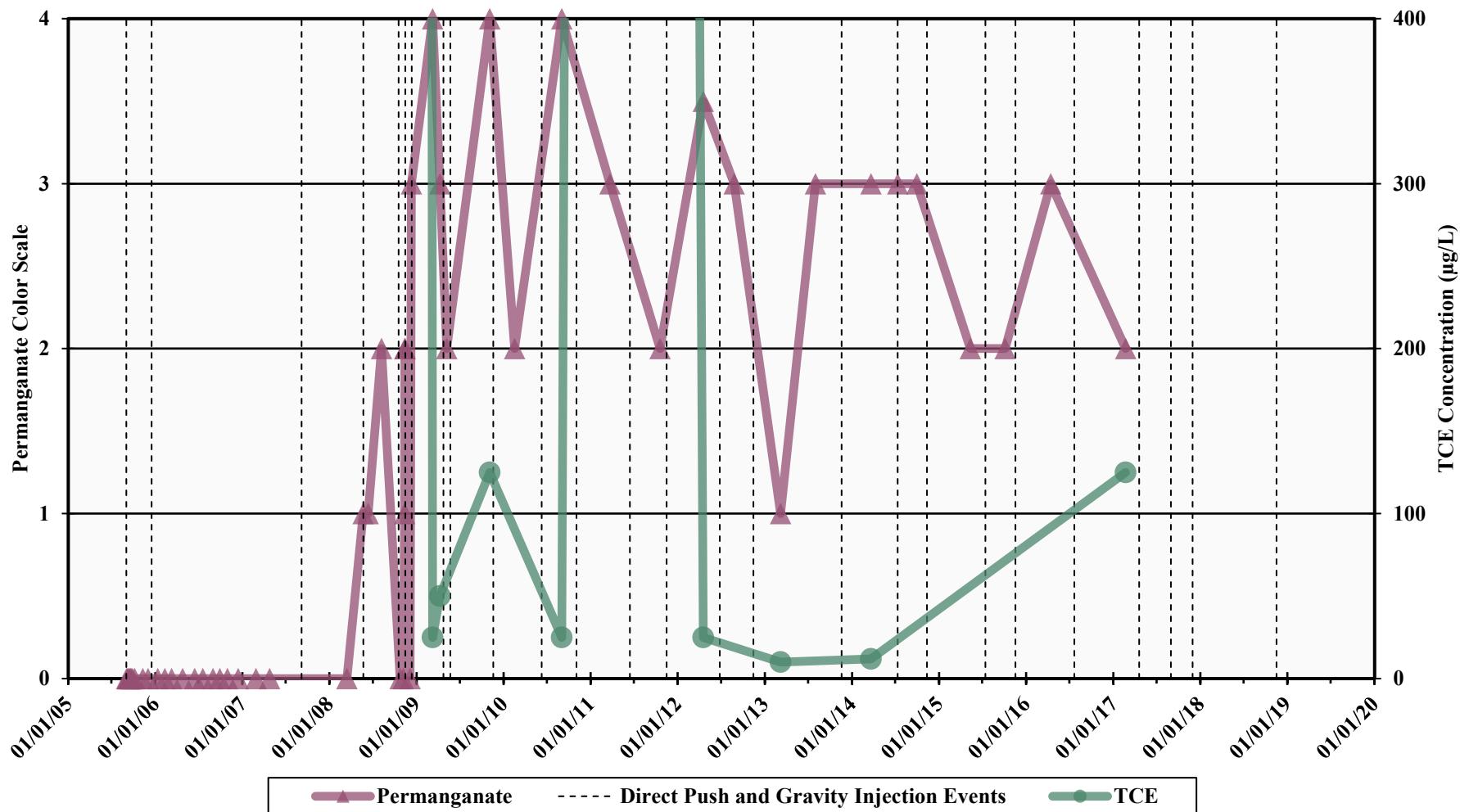
**WELL MW-204S**  
**SODIUM PERMANGANATE AND TCE CONCENTRATIONS VS. TIME**



**NOTES:**

1. TCE = trichloroethylene.
2.  $\mu\text{g/L}$  = micrograms per liter.

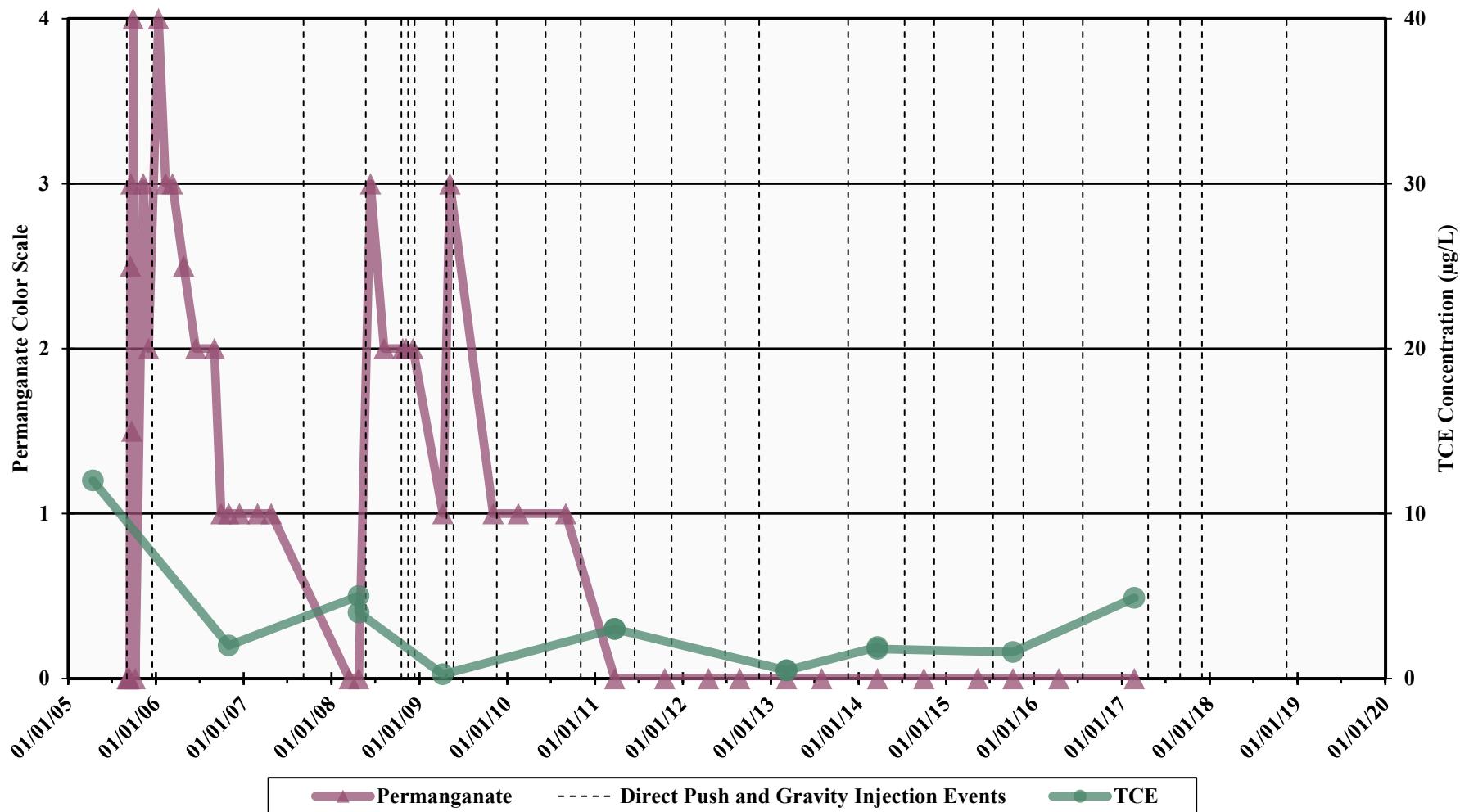
**WELL MW-204D**  
**SODIUM PERMANGANATE AND TCE CONCENTRATIONS VS. TIME**



**NOTES:**

1. TCE = trichloroethylene.
2.  $\mu\text{g/L}$  = micrograms per liter.

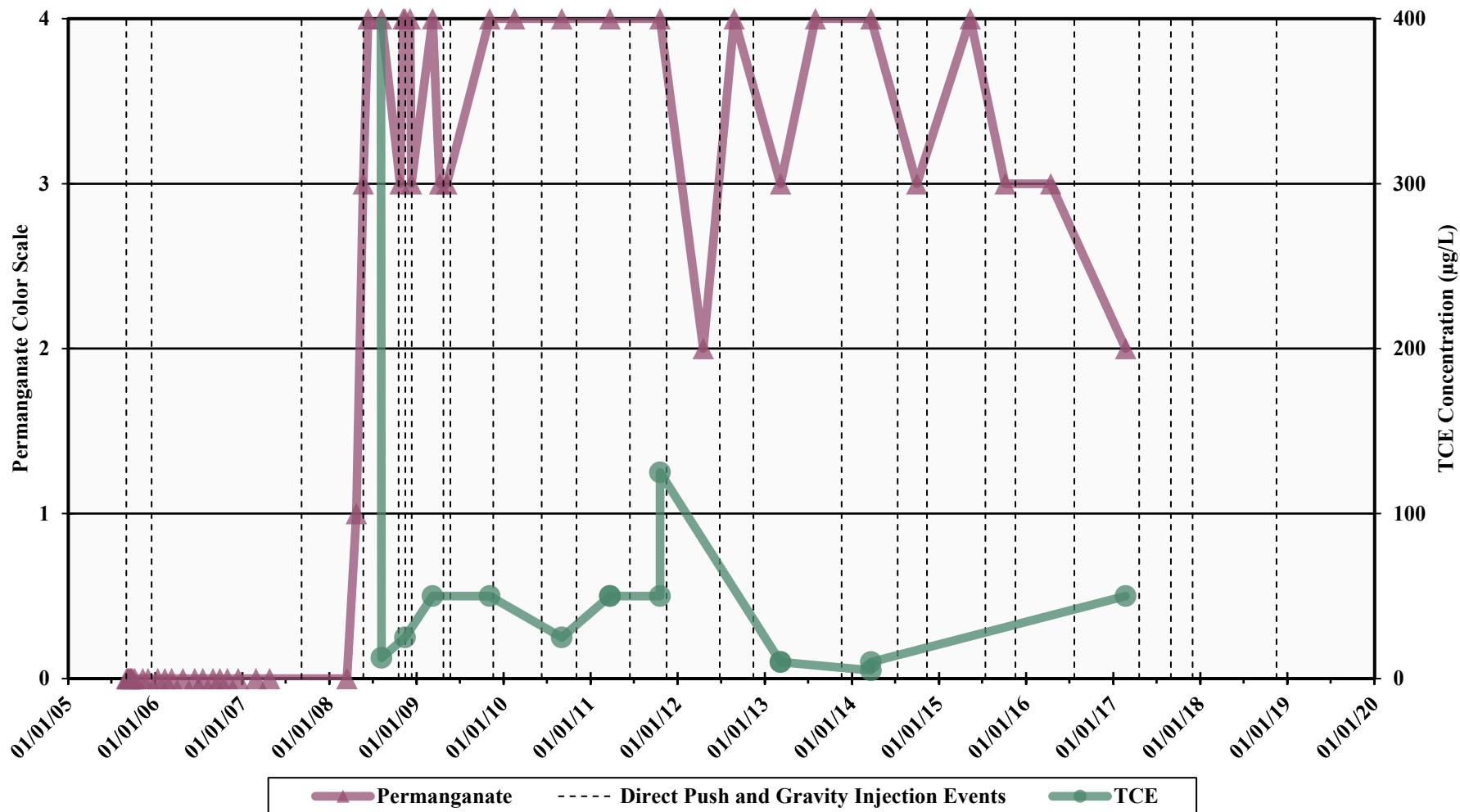
**WELL MW-205S**  
**SODIUM PERMANGANATE AND TCE CONCENTRATIONS VS. TIME**



**NOTES:**

1. TCE = trichloroethylene.
2. µg/L = micrograms per liter.

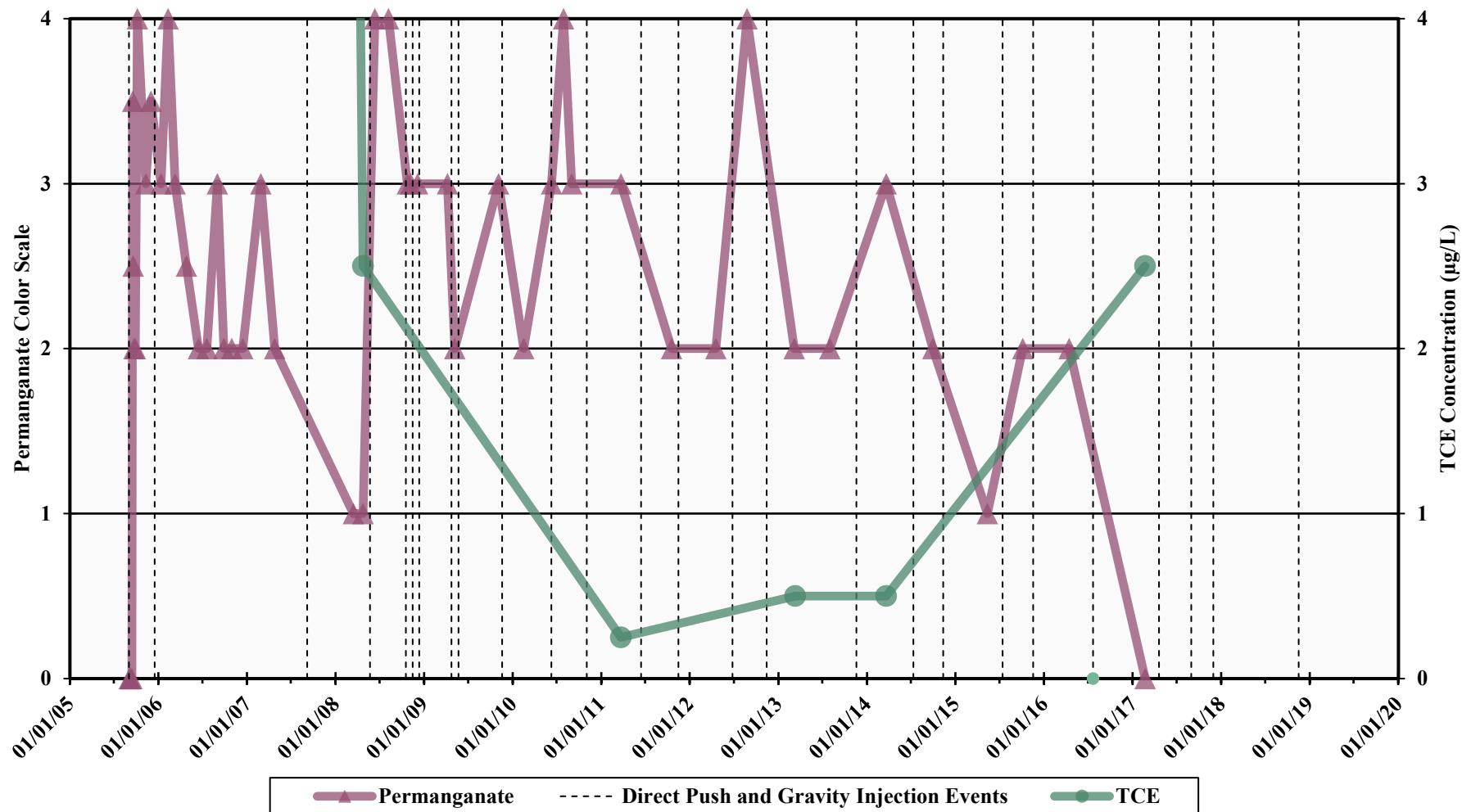
**WELL MW-205D**  
**SODIUM PERMANGANATE AND TCE CONCENTRATIONS VS. TIME**



**NOTES:**

1. TCE = trichloroethylene.
2.  $\mu\text{g/L}$  = micrograms per liter.

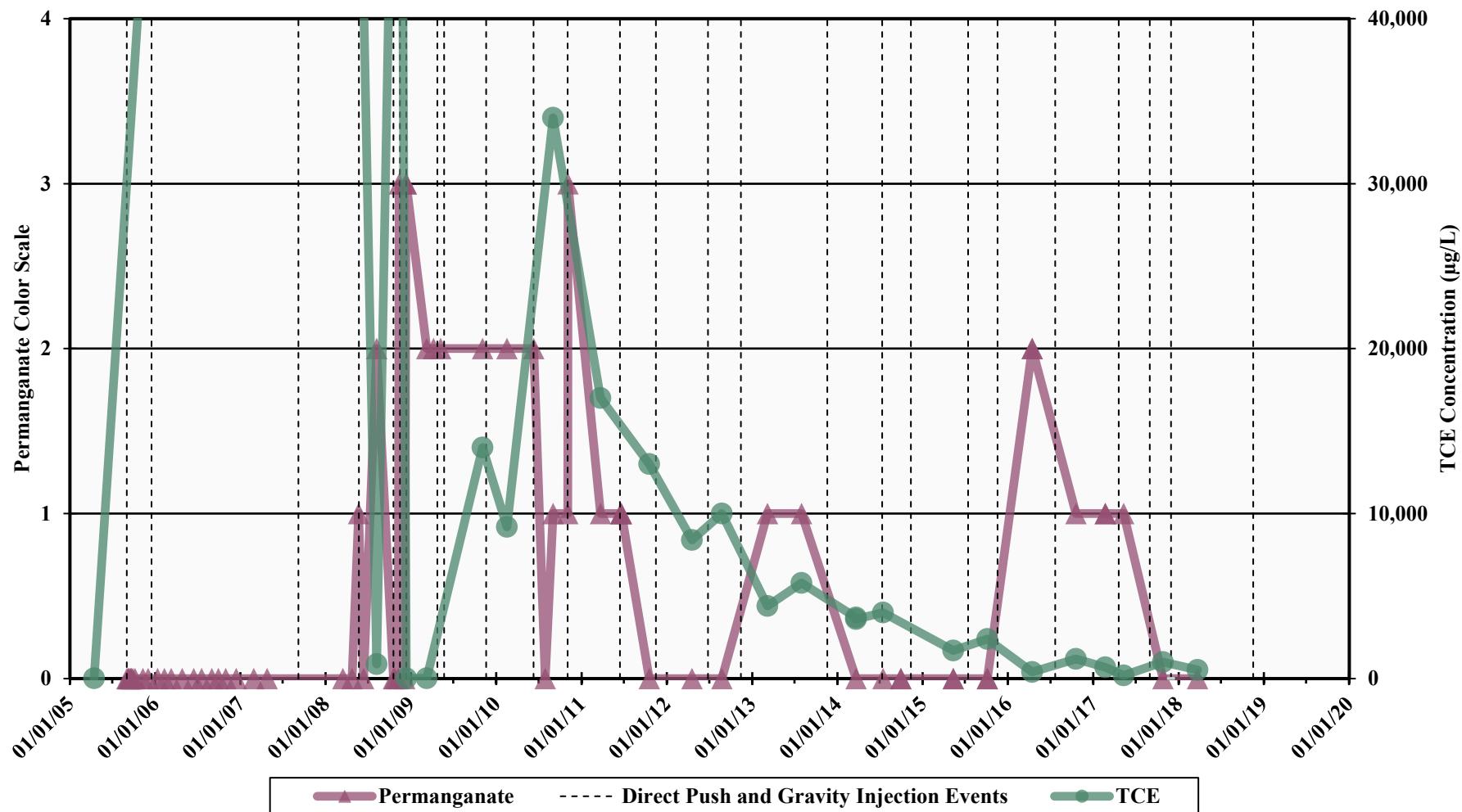
**WELL MW-206S**  
**SODIUM PERMANGANATE AND TCE CONCENTRATIONS VS. TIME**



**NOTES:**

1. TCE = trichloroethylene.
2.  $\mu\text{g/L}$  = micrograms per liter.

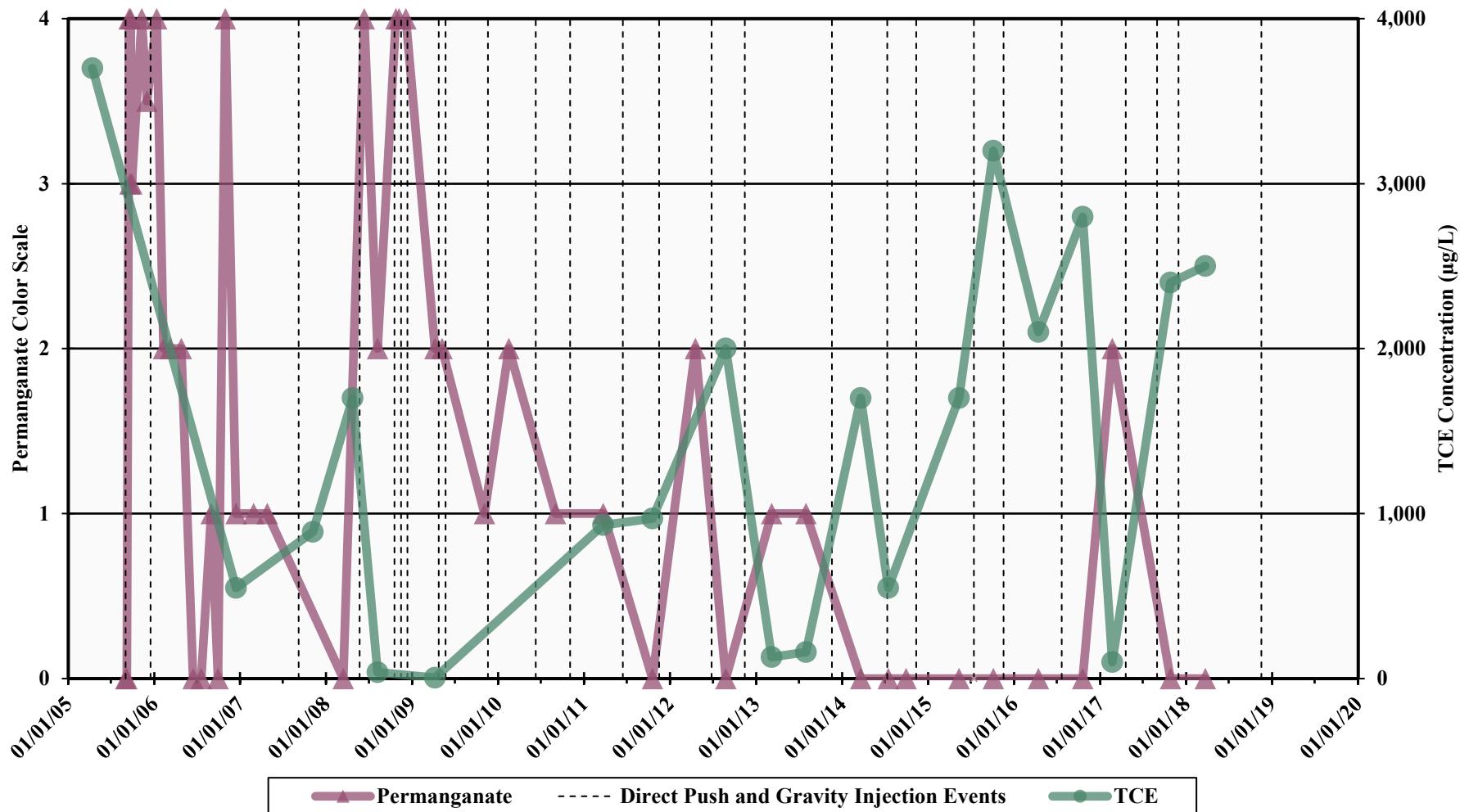
**WELL MW-206D**  
**SODIUM PERMANGANATE AND TCE CONCENTRATIONS VS. TIME**



**NOTES:**

1. TCE = trichloroethylene.
2.  $\mu\text{g/L}$  = micrograms per liter.

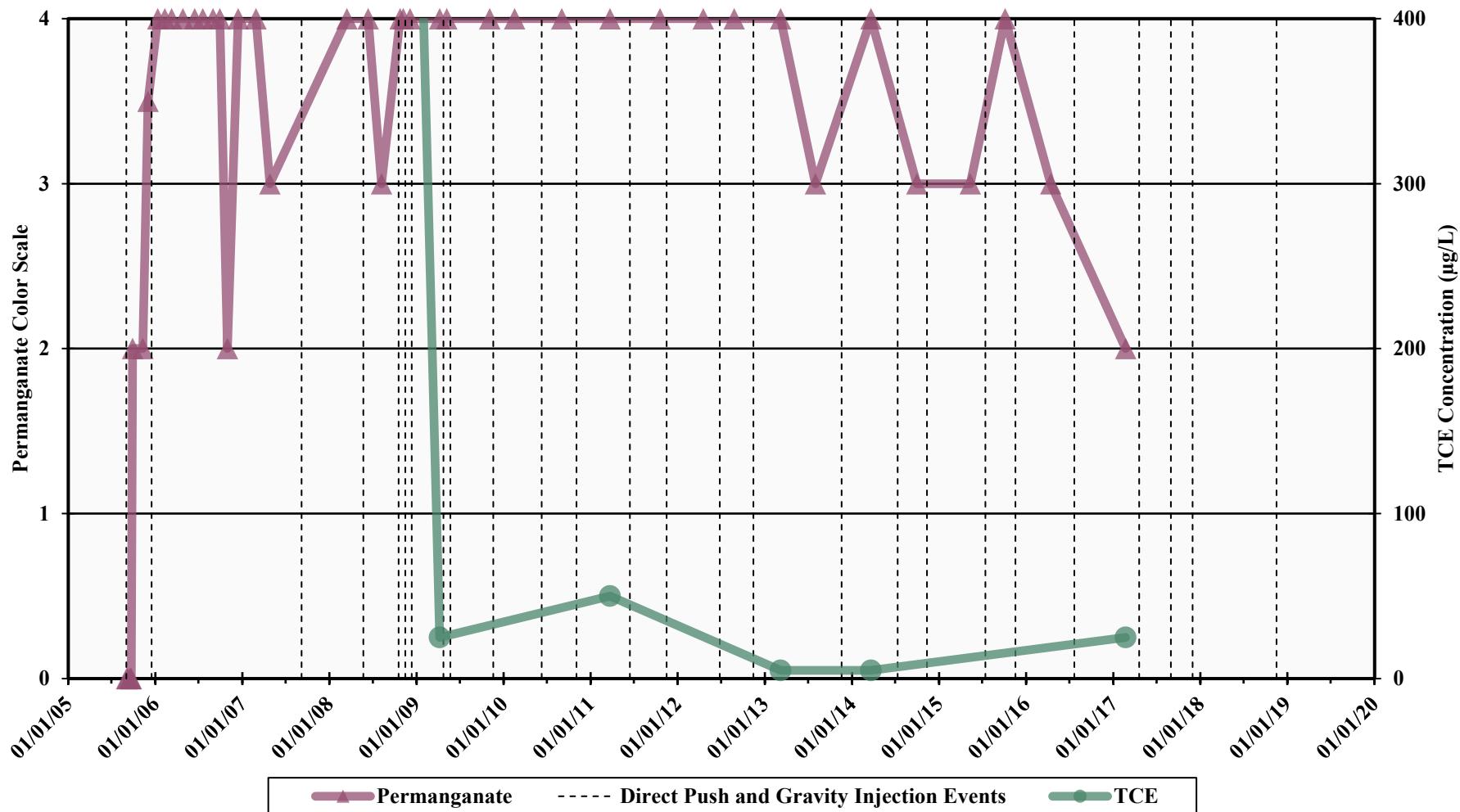
**WELL MW-207S**  
**SODIUM PERMANGANATE AND TCE CONCENTRATIONS VS. TIME**



**NOTES:**

1. TCE = trichloroethylene.
2. µg/L = micrograms per liter.

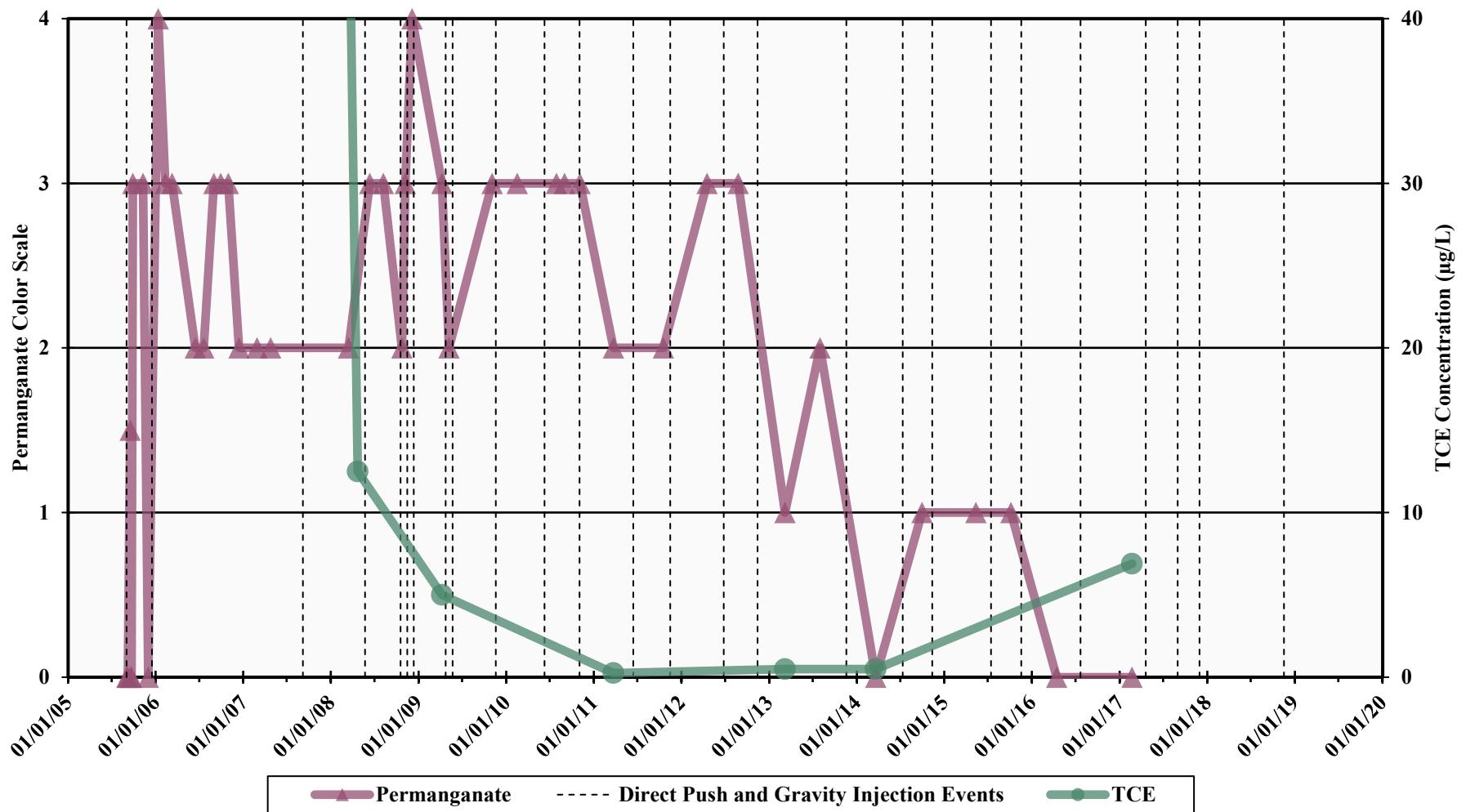
**WELL MW-207D**  
**SODIUM PERMANGANATE AND TCE CONCENTRATIONS VS. TIME**



**NOTES:**

1. TCE = trichloroethylene.
2.  $\mu\text{g/L}$  = micrograms per liter.

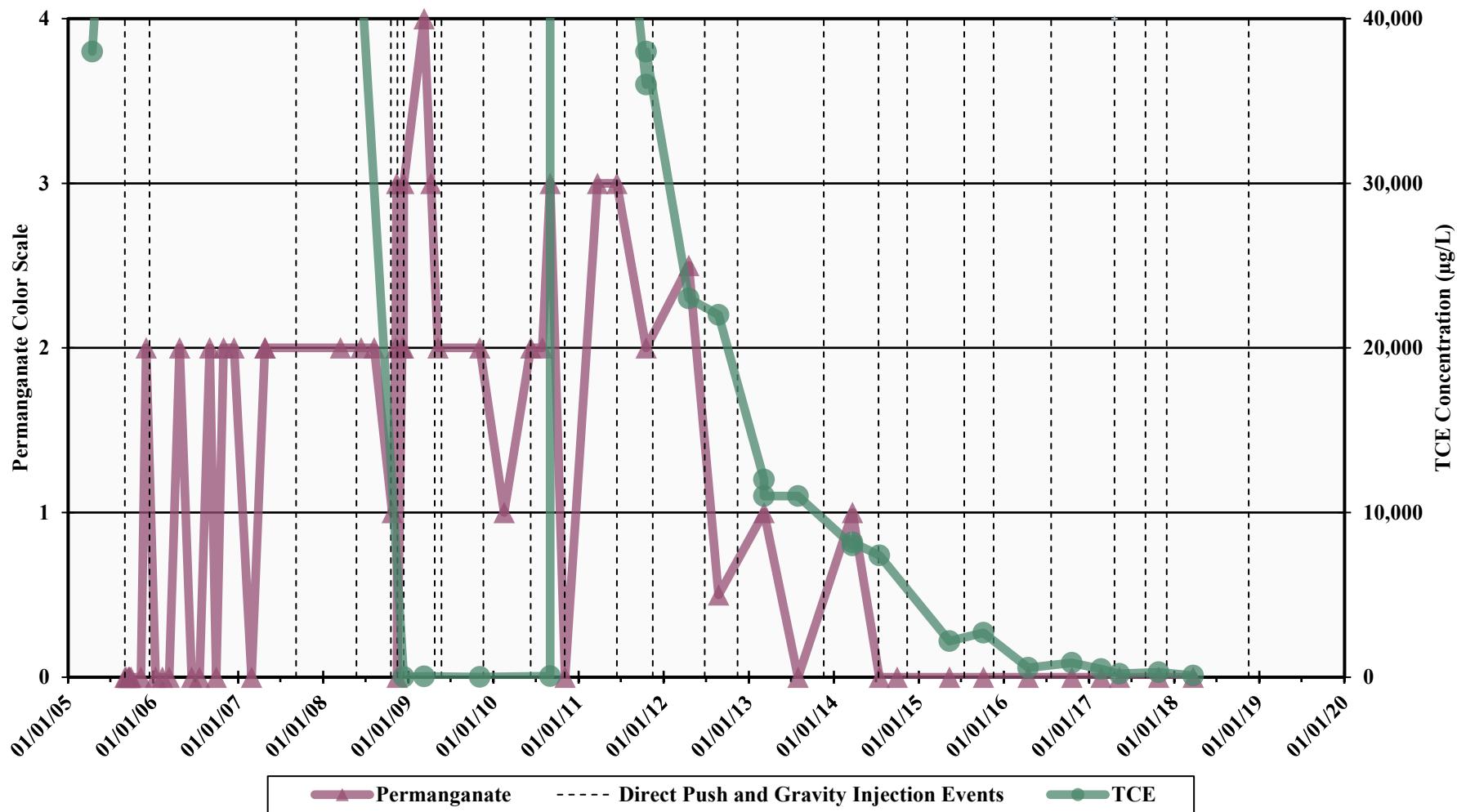
**WELL MW-208S**  
**SODIUM PERMANGANATE AND TCE CONCENTRATIONS VS. TIME**



**NOTES:**

1. TCE = trichloroethylene.
2.  $\mu\text{g/L}$  = micrograms per liter.

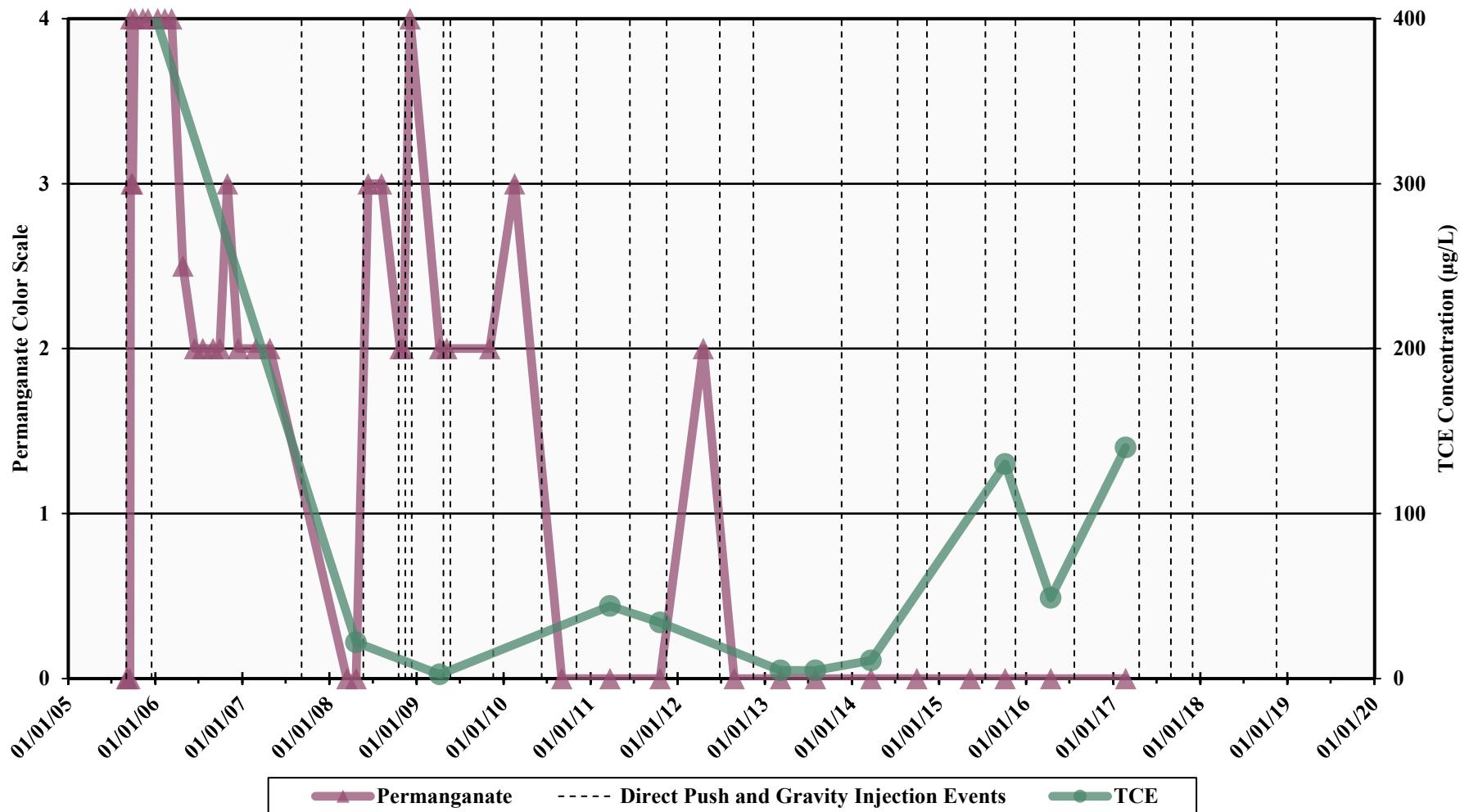
**WELL MW-208D**  
**SODIUM PERMANGANATE AND TCE CONCENTRATIONS VS. TIME**



**NOTES:**

1. TCE = trichloroethylene.
2.  $\mu\text{g/L}$  = micrograms per liter.

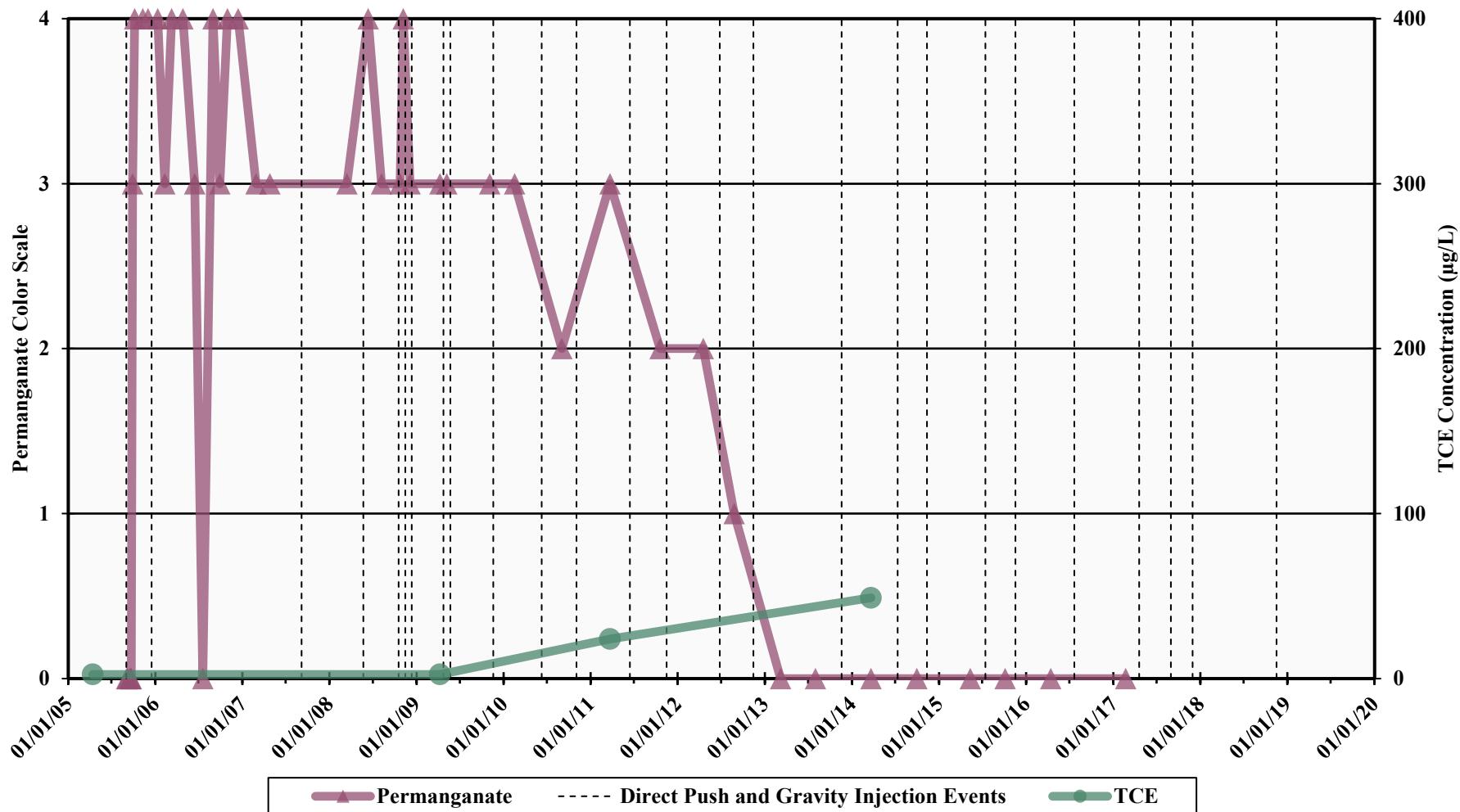
**WELL MW-209S**  
**SODIUM PERMANGANATE AND TCE CONCENTRATIONS VS. TIME**



**NOTES:**

1. TCE = trichloroethylene.
2. µg/L = micrograms per liter.

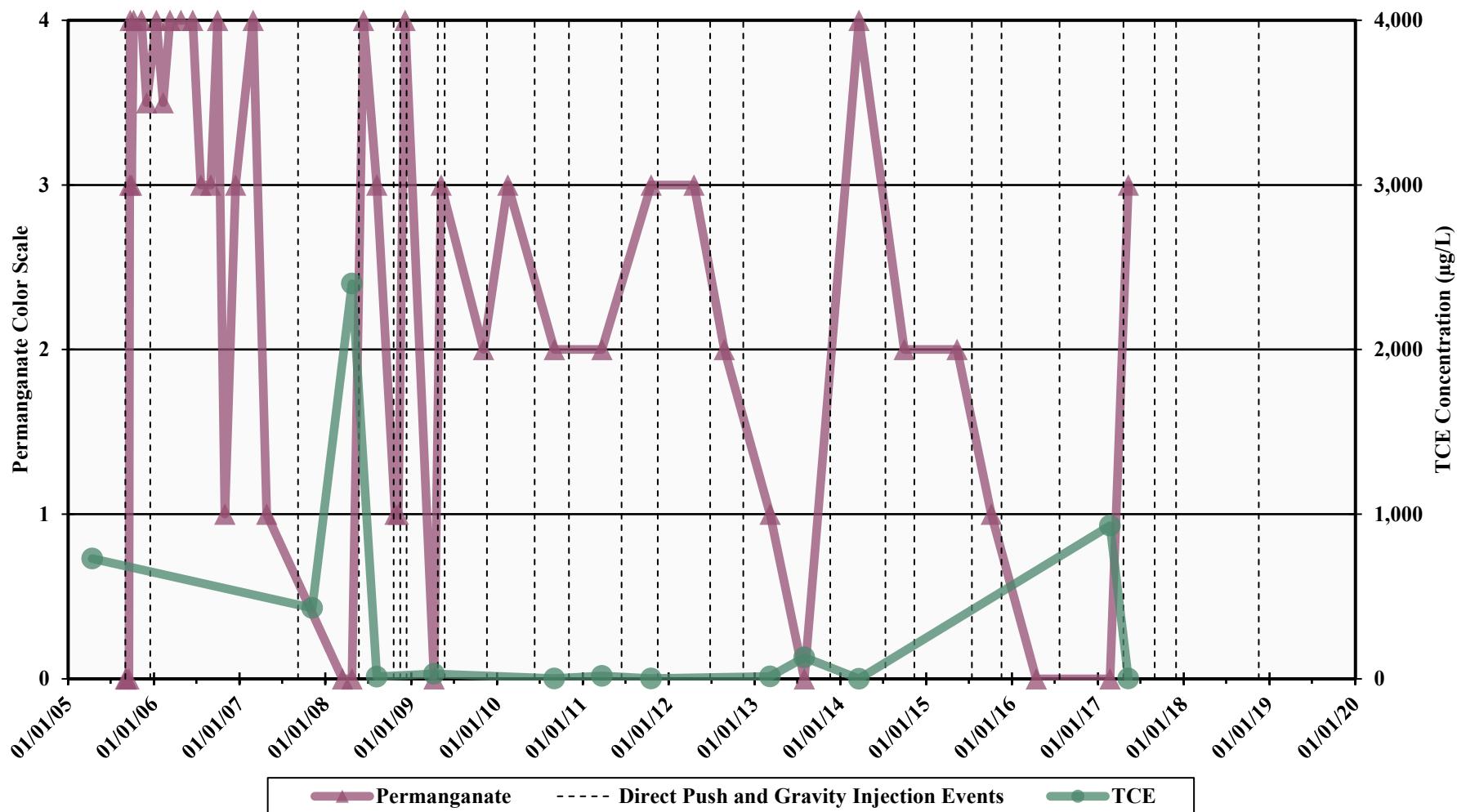
**WELL MW-209D**  
**SODIUM PERMANGANATE AND TCE CONCENTRATIONS VS. TIME**



**NOTES:**

1. TCE = trichloroethylene.
2.  $\mu\text{g/L}$  = micrograms per liter.

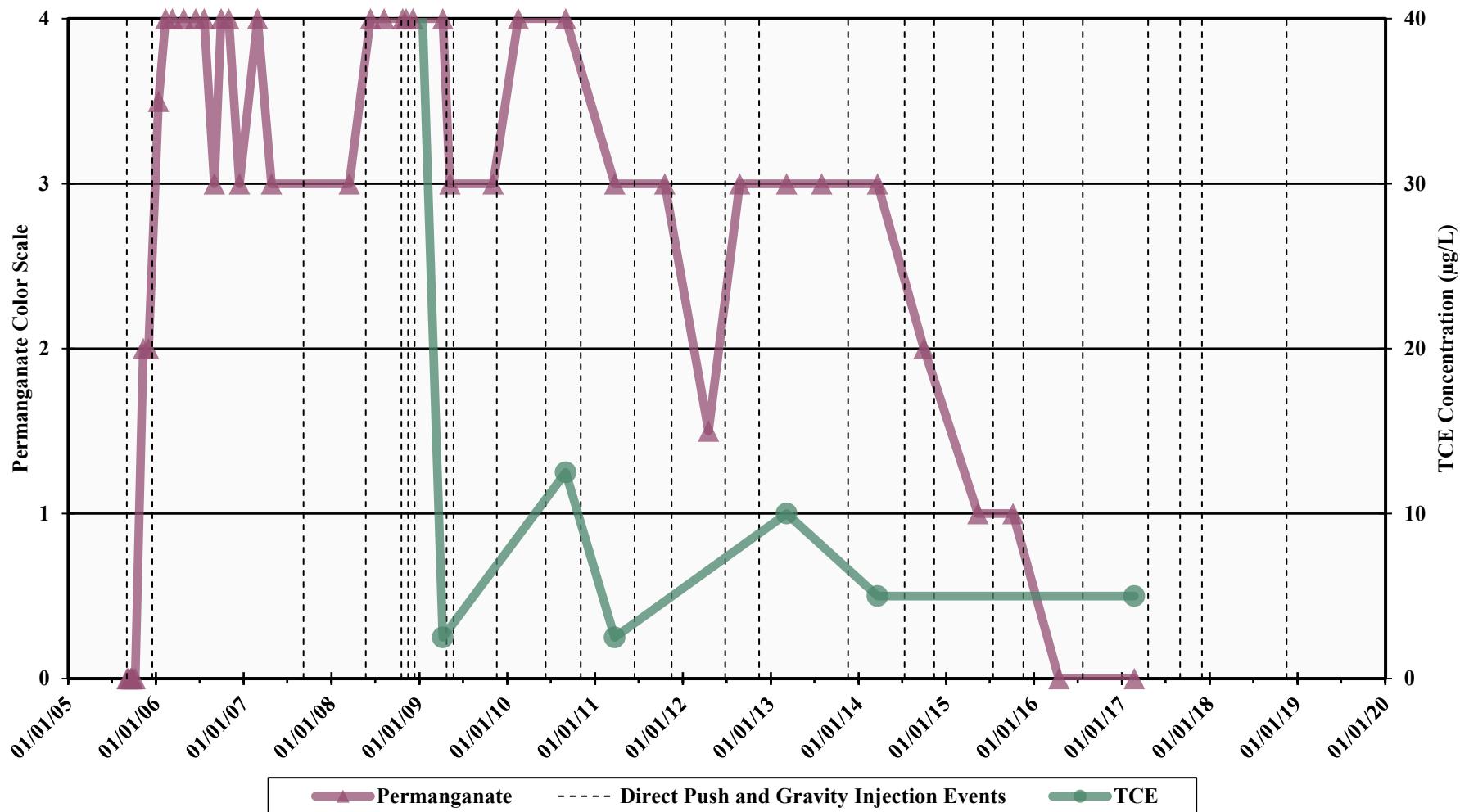
**WELL MW-210S**  
**SODIUM PERMANGANATE AND TCE CONCENTRATIONS VS. TIME**



**NOTES:**

1. TCE = trichloroethylene.
2. µg/L = micrograms per liter.

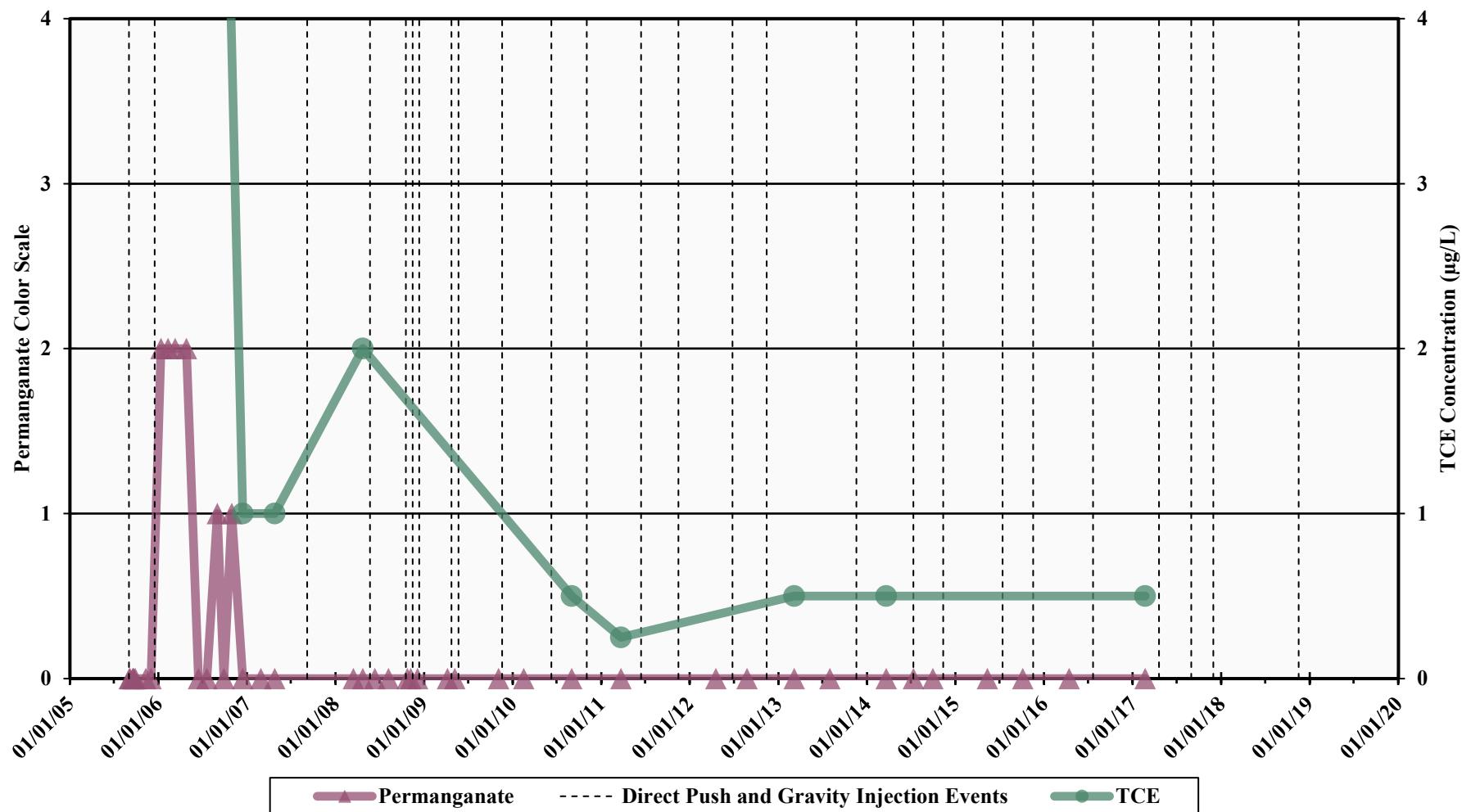
**WELL MW-210D**  
**SODIUM PERMANGANATE AND TCE CONCENTRATIONS VS. TIME**



**NOTES:**

1. TCE = trichloroethylene.
2.  $\mu\text{g/L}$  = micrograms per liter.

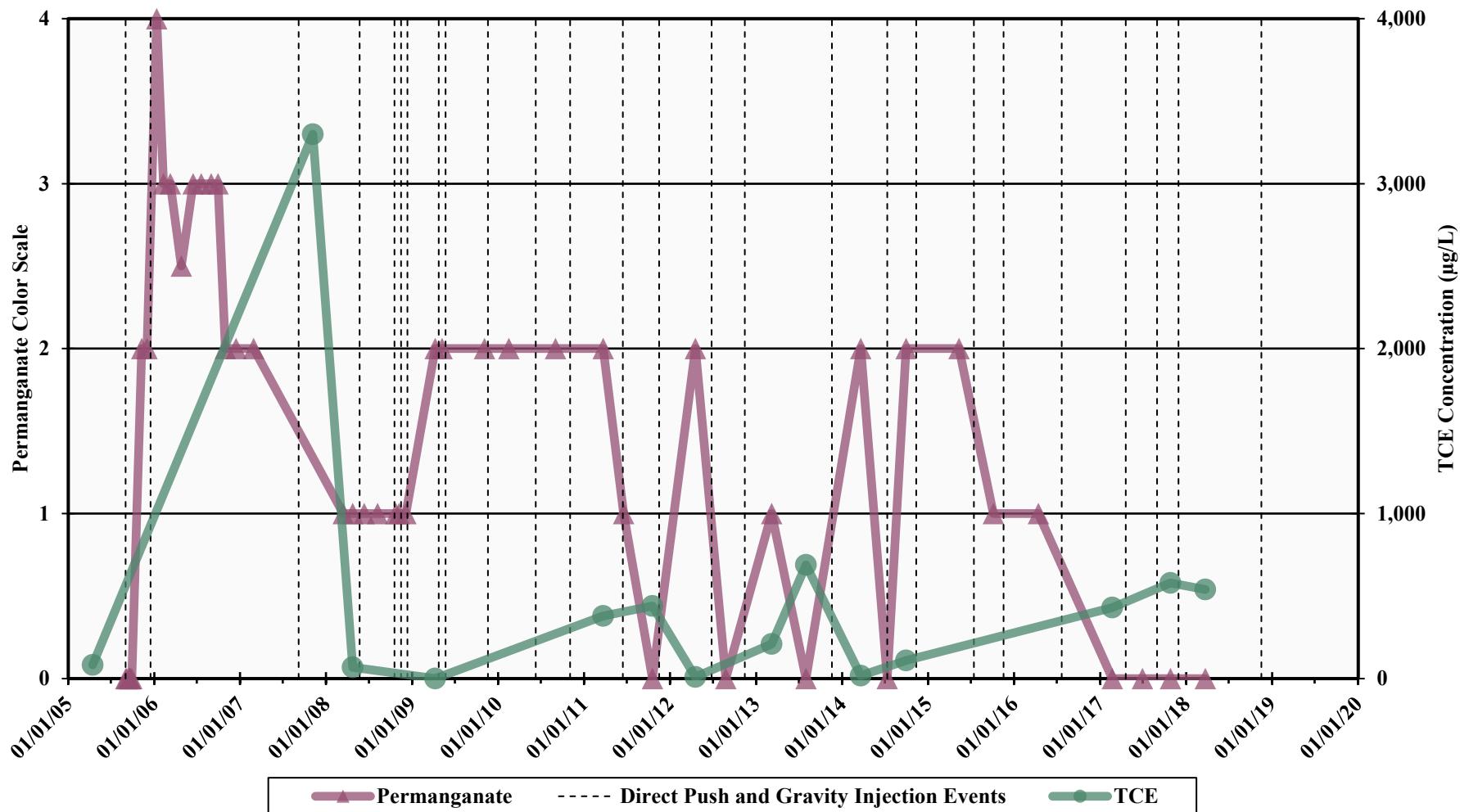
**WELL MW-211S**  
**SODIUM PERMANGANATE AND TCE CONCENTRATIONS VS. TIME**



**NOTES:**

1. TCE = trichloroethylene.
2.  $\mu\text{g/L}$  = micrograms per liter.

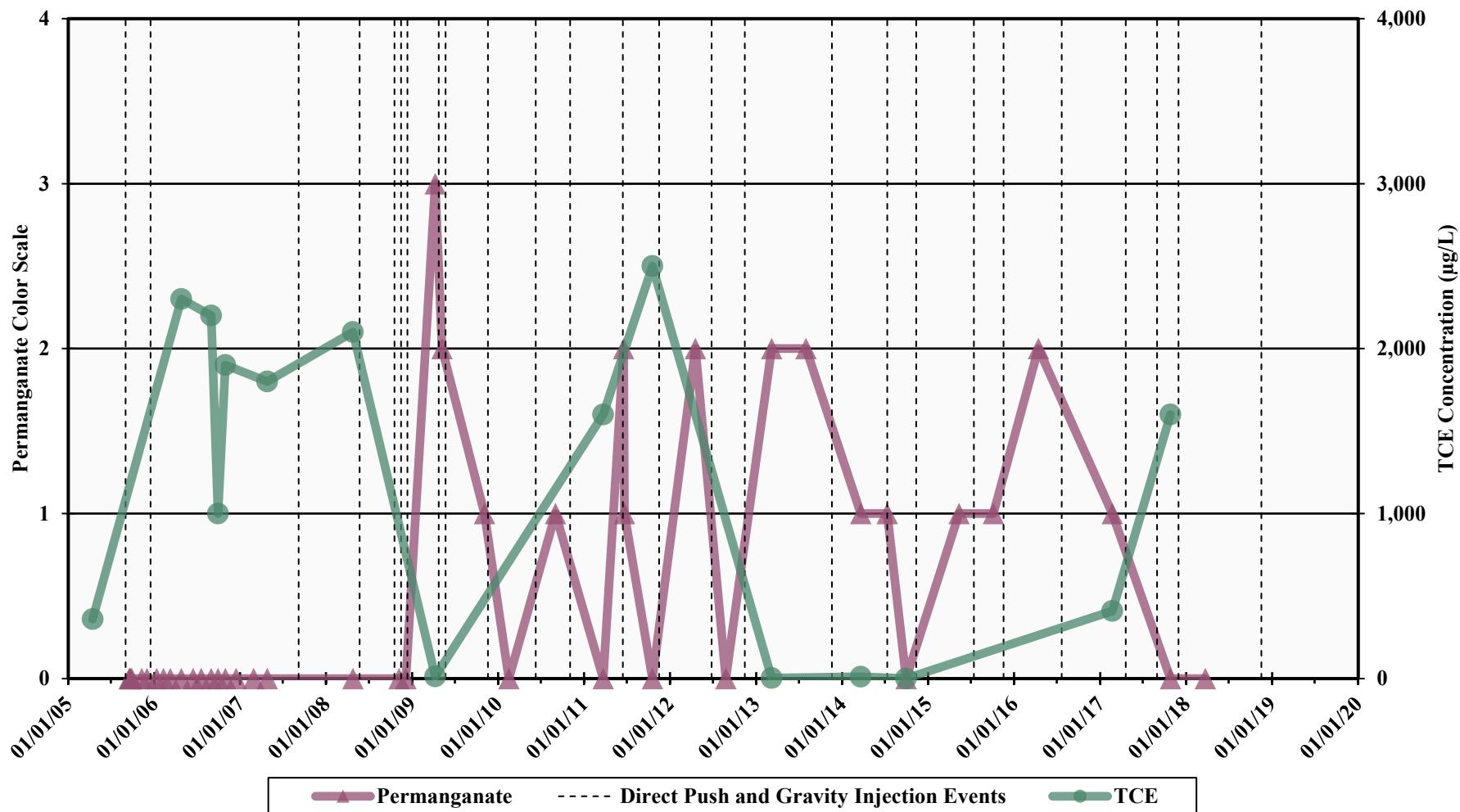
**WELL MW-211D**  
**SODIUM PERMANGANATE AND TCE CONCENTRATIONS VS. TIME**



**NOTES:**

1. TCE = trichloroethylene.
2. µg/L = micrograms per liter.

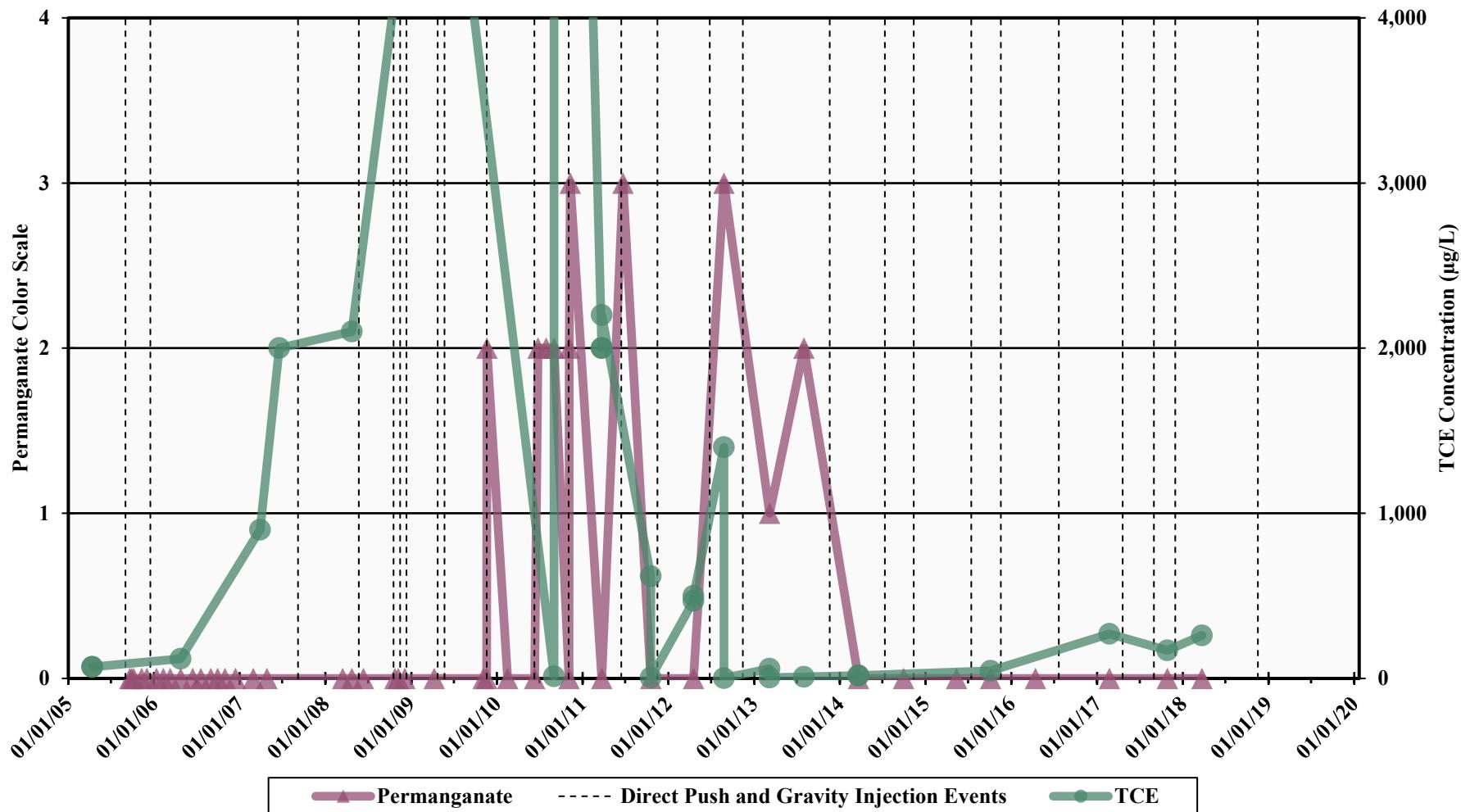
**WELL MW-212S**  
**SODIUM PERMANGANATE AND TCE CONCENTRATIONS VS. TIME**



**NOTES:**

1. TCE = trichloroethylene.
2.  $\mu\text{g/L}$  = micrograms per liter.

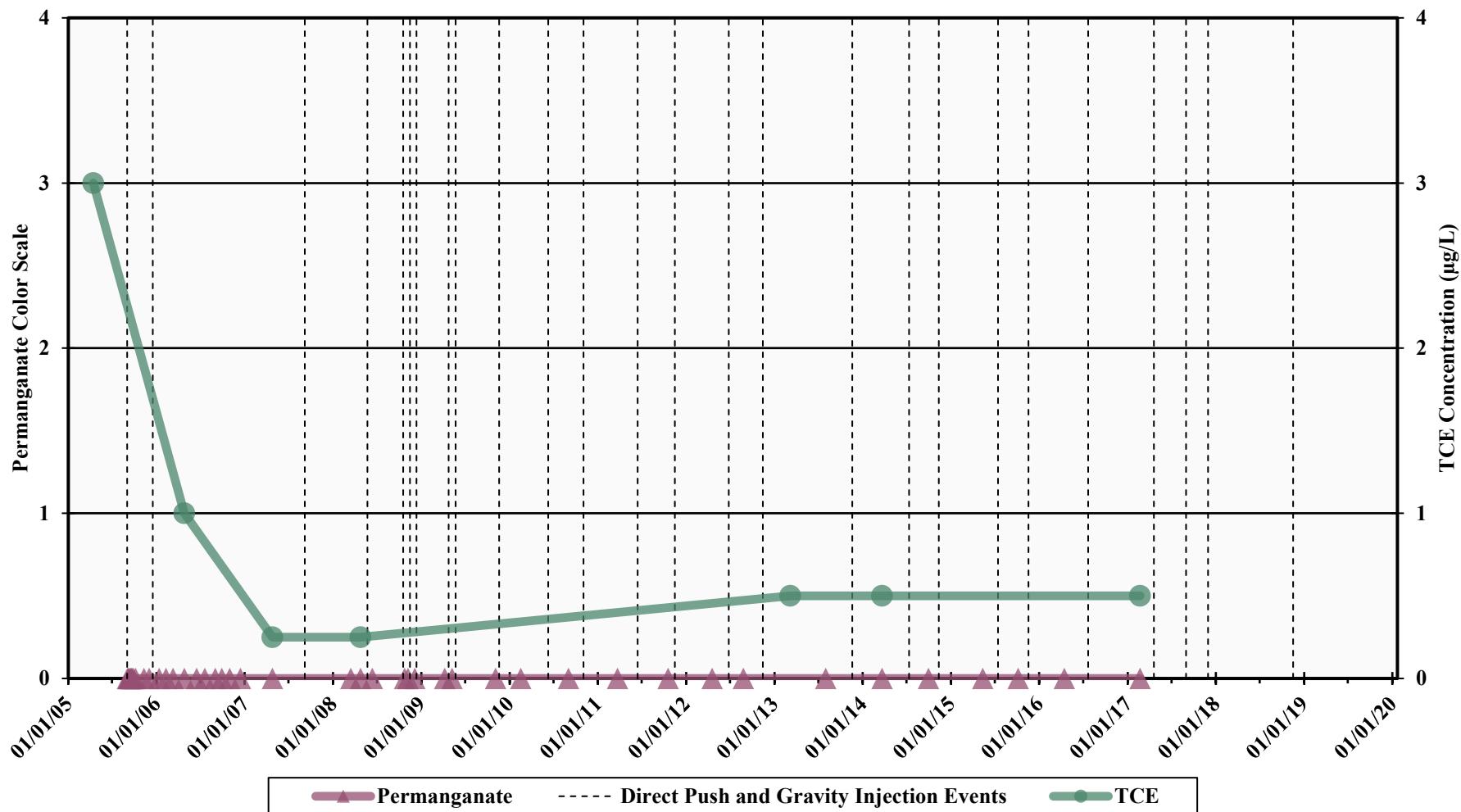
**WELL MW-213S**  
**SODIUM PERMANGANATE AND TCE CONCENTRATIONS VS. TIME**



**NOTES:**

1. TCE = trichloroethylene.
2.  $\mu\text{g/L}$  = micrograms per liter.

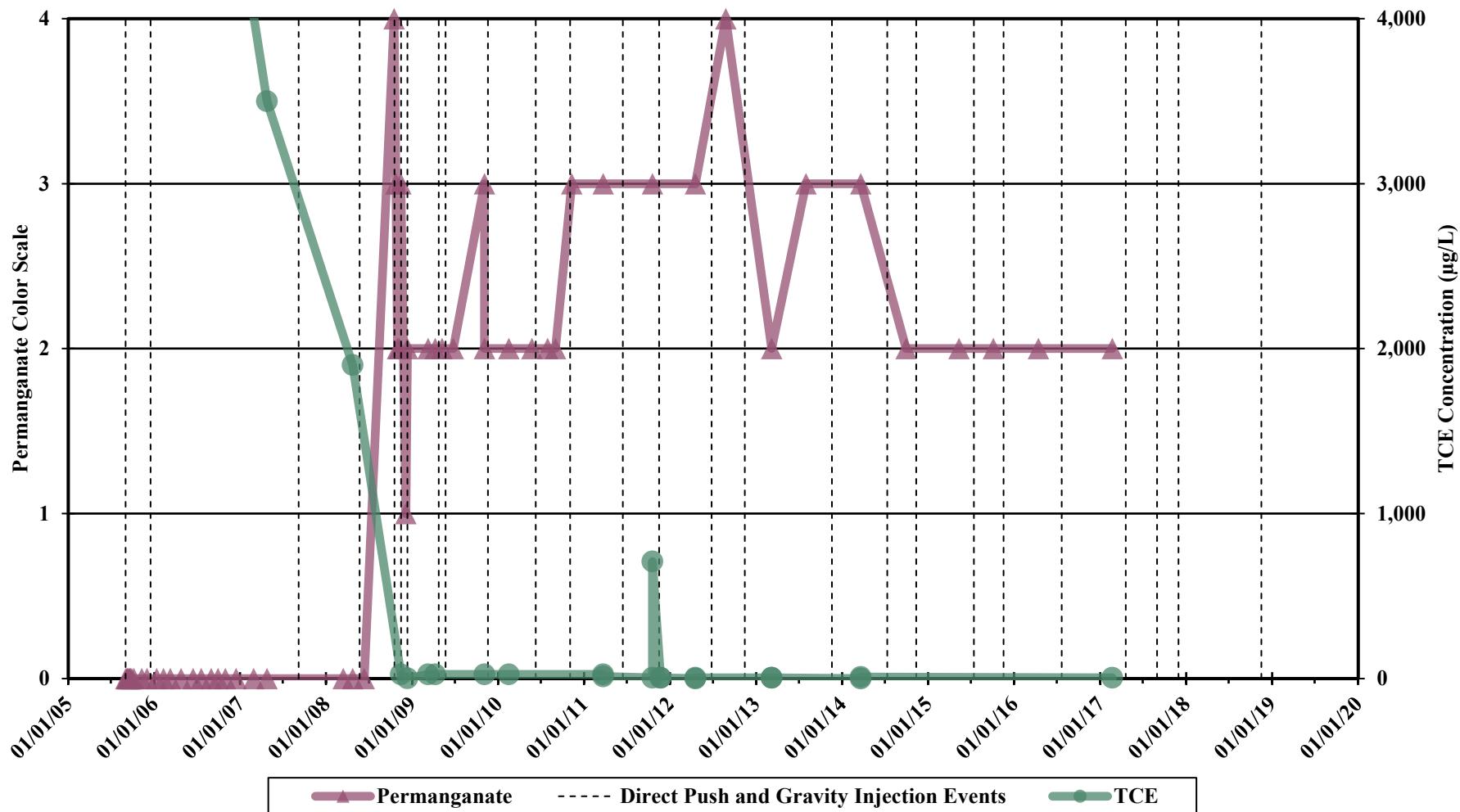
**WELL MW-214S**  
**SODIUM PERMANGANATE AND TCE CONCENTRATIONS VS. TIME**



**NOTES:**

1. TCE = trichloroethylene.
2.  $\mu\text{g/L}$  = micrograms per liter.

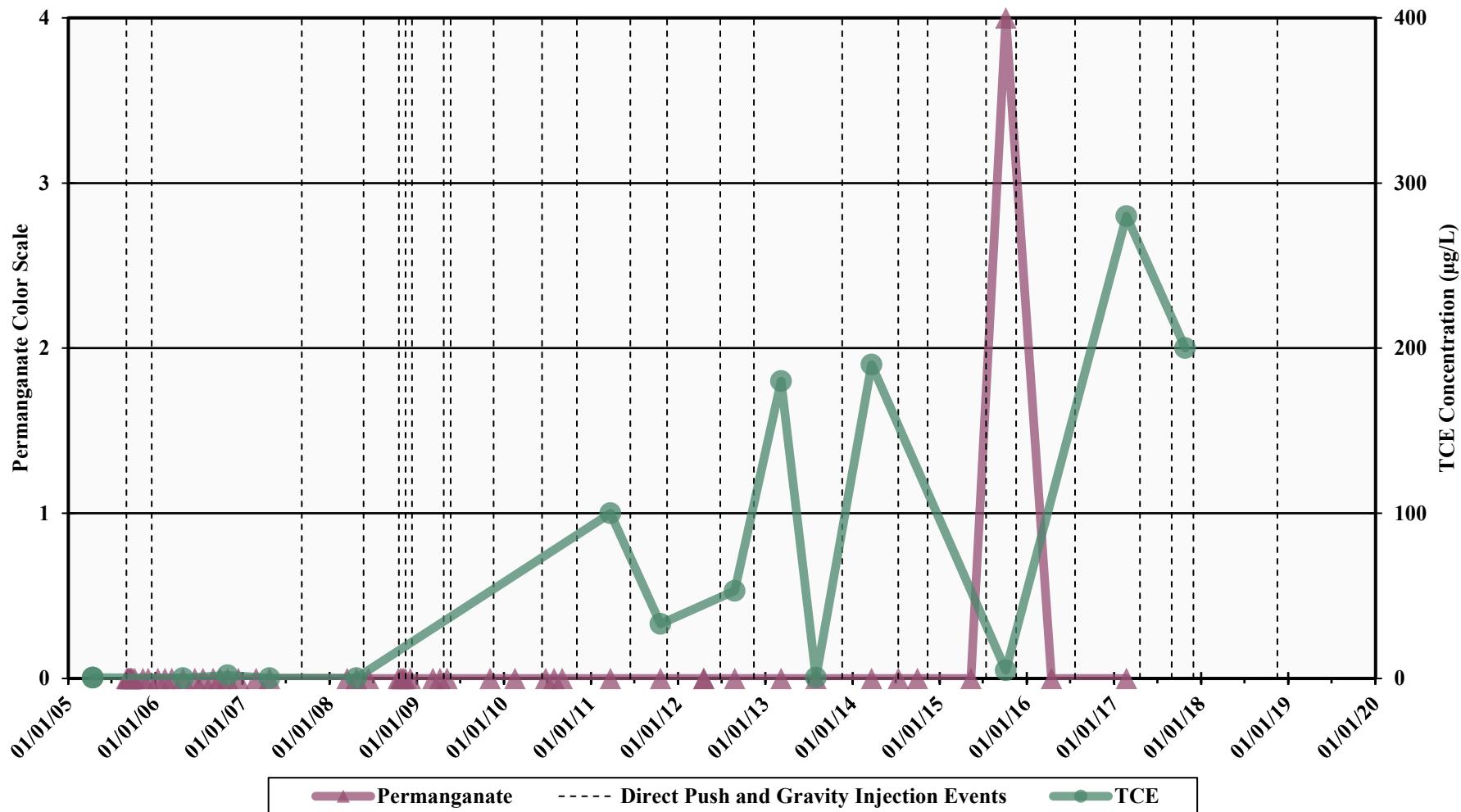
**WELL MW-215S**  
**SODIUM PERMANGANATE AND TCE CONCENTRATIONS VS. TIME**



**NOTES:**

1. TCE = trichloroethylene.
2. µg/L = micrograms per liter.

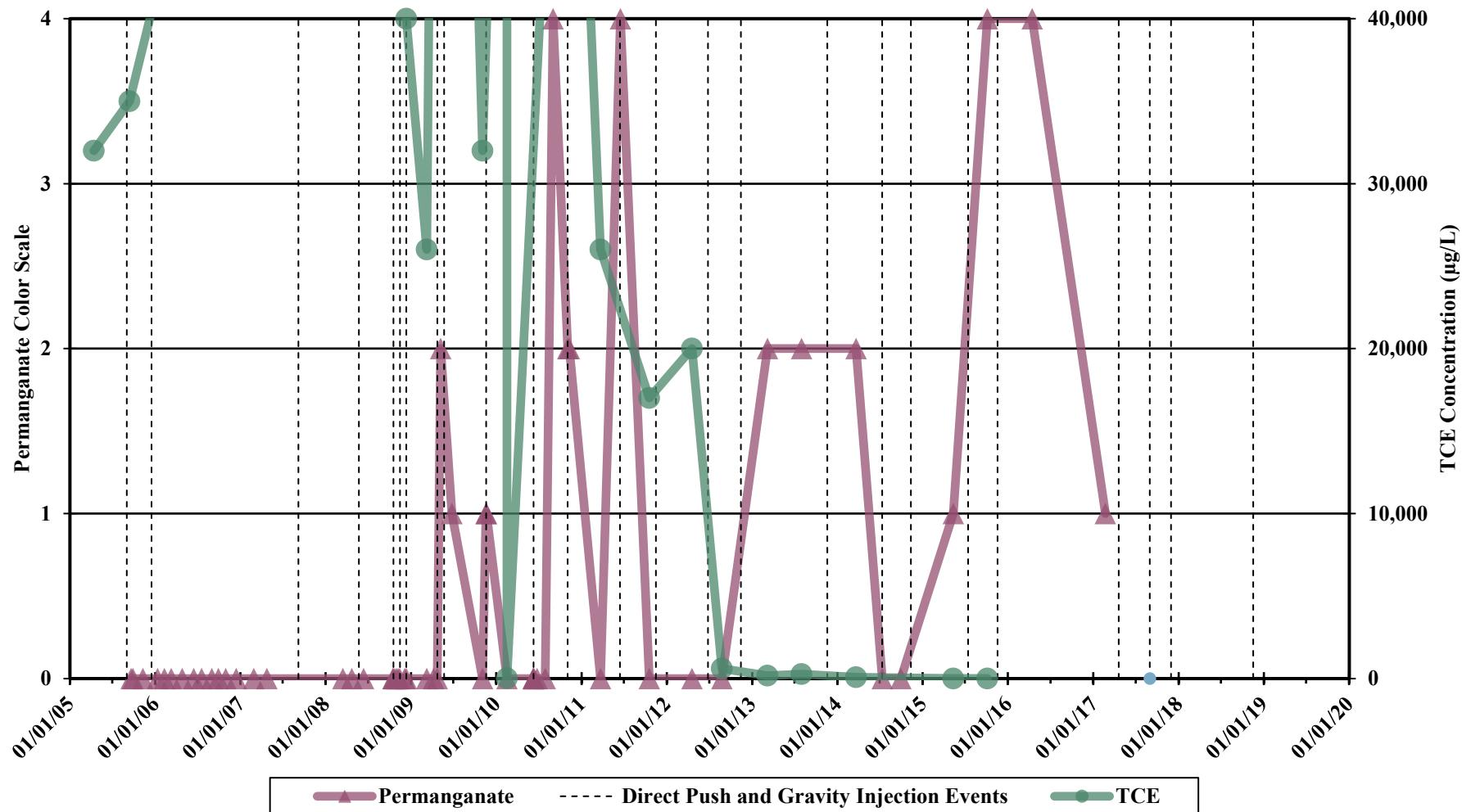
**WELL MW-215M**  
**SODIUM PERMANGANATE AND TCE CONCENTRATIONS VS. TIME**



**NOTES:**

1. TCE = trichloroethylene.
2. µg/L = micrograms per liter.

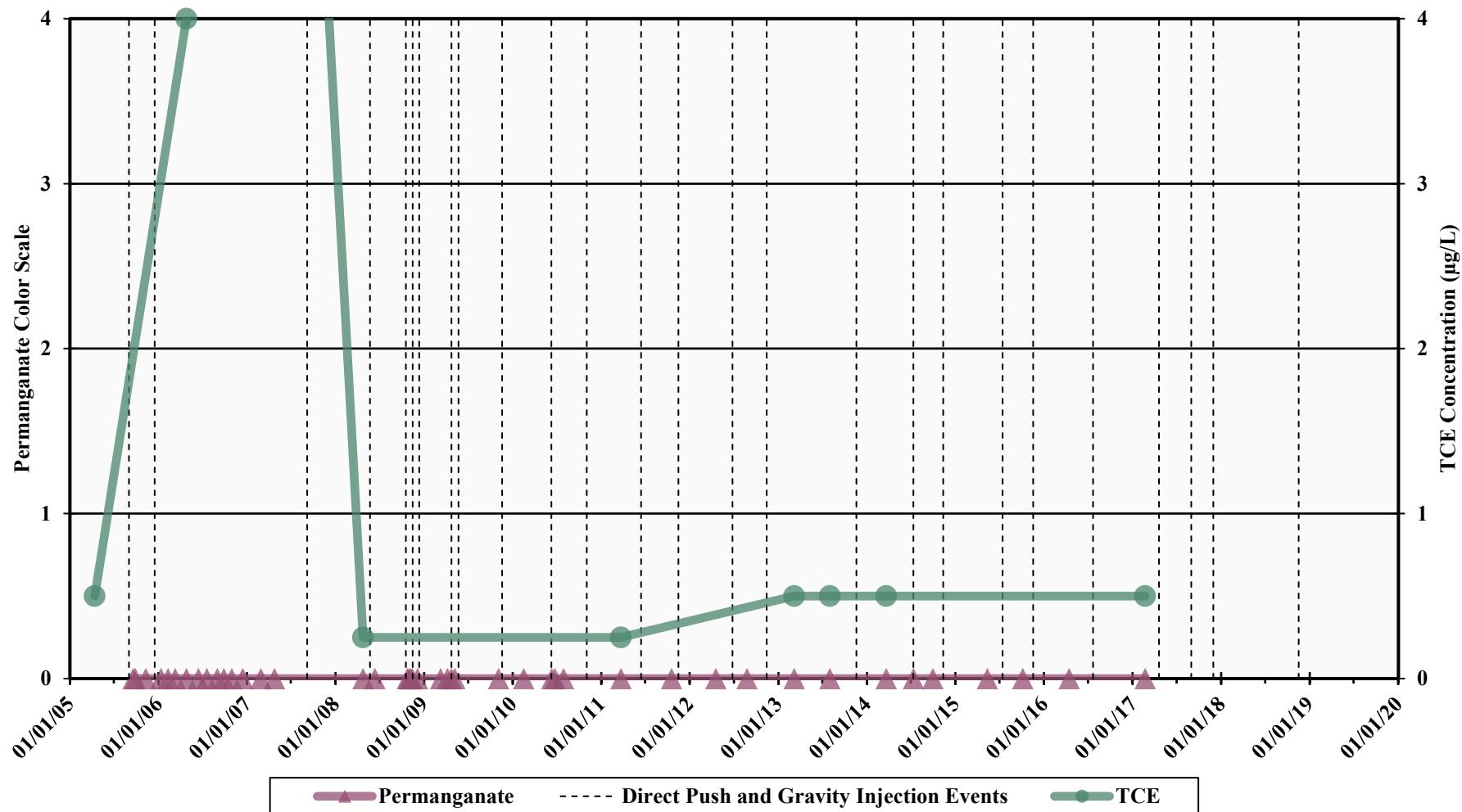
**WELL MW-216S**  
**SODIUM PERMANGANATE AND TCE CONCENTRATIONS VS. TIME**



**NOTES:**

1. TCE = trichloroethylene.
2. µg/L = micrograms per liter.

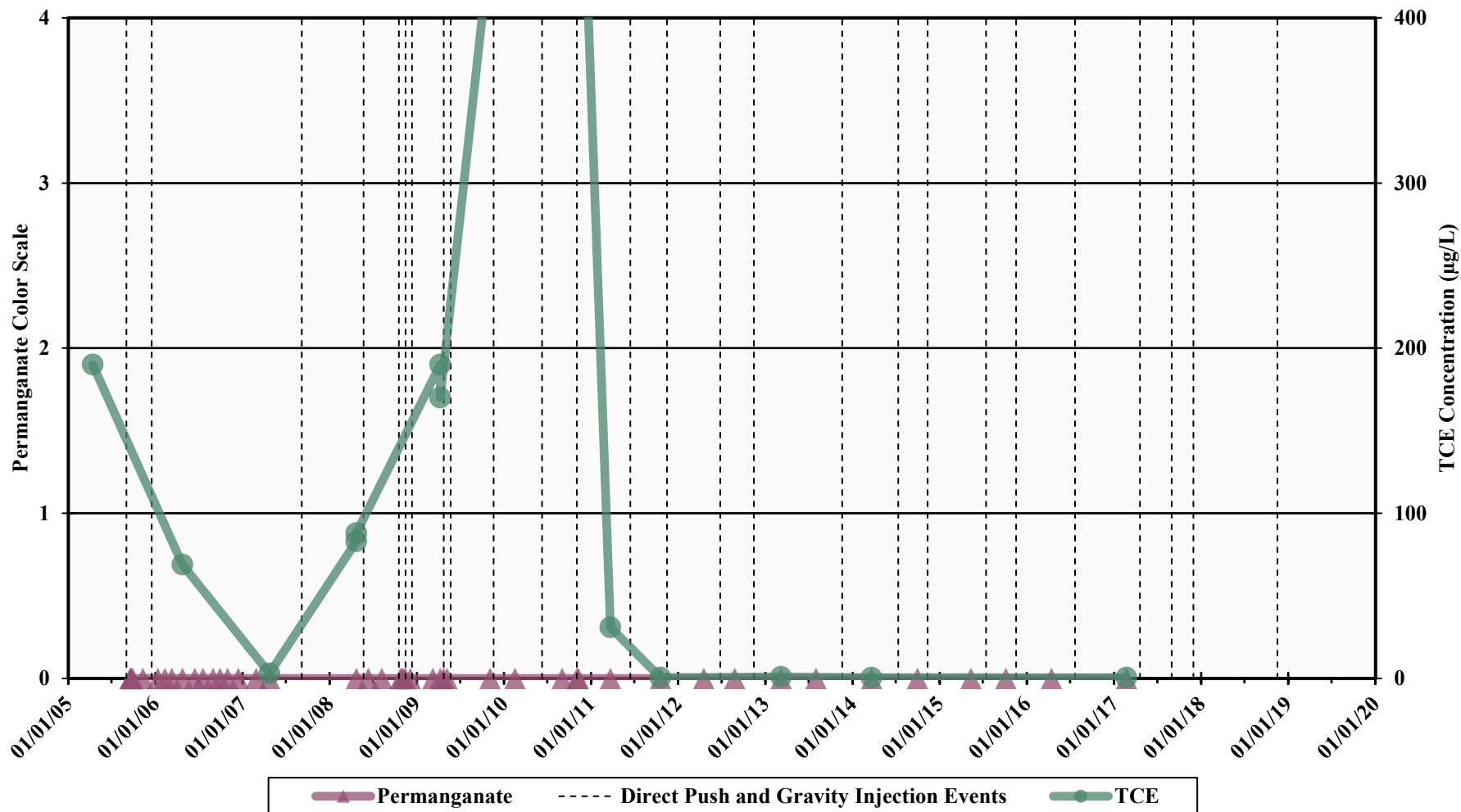
**WELL MW-216M**  
**SODIUM PERMANGANATE AND TCE CONCENTRATIONS VS. TIME**



**NOTES:**

1. TCE = trichloroethylene.
2. µg/L = micrograms per liter.

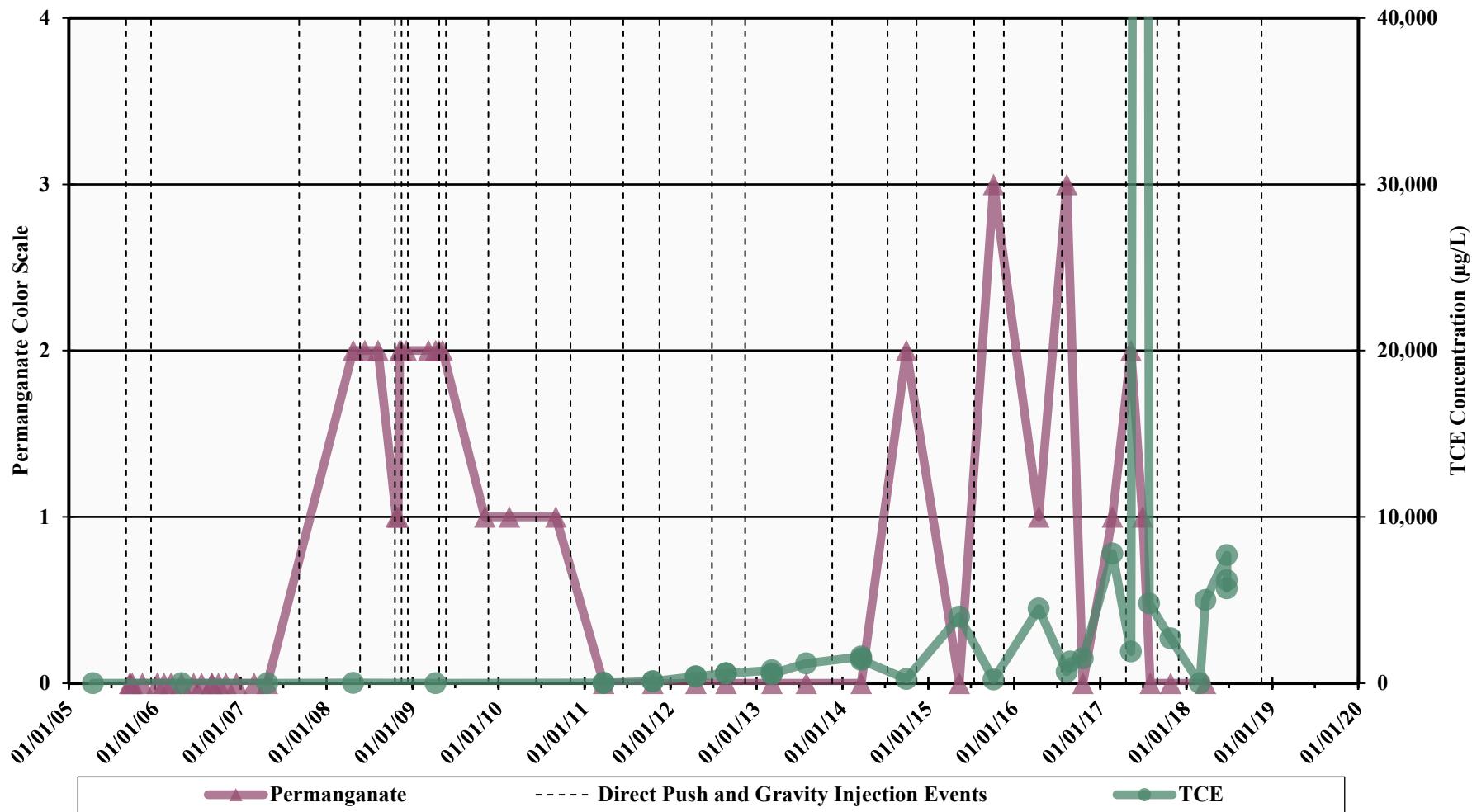
**WELL MW-217S**  
**SODIUM PERMANGANATE AND TCE CONCENTRATIONS VS. TIME**



**NOTES:**

1. TCE = trichloroethylene.
2. µg/L = micrograms per liter.

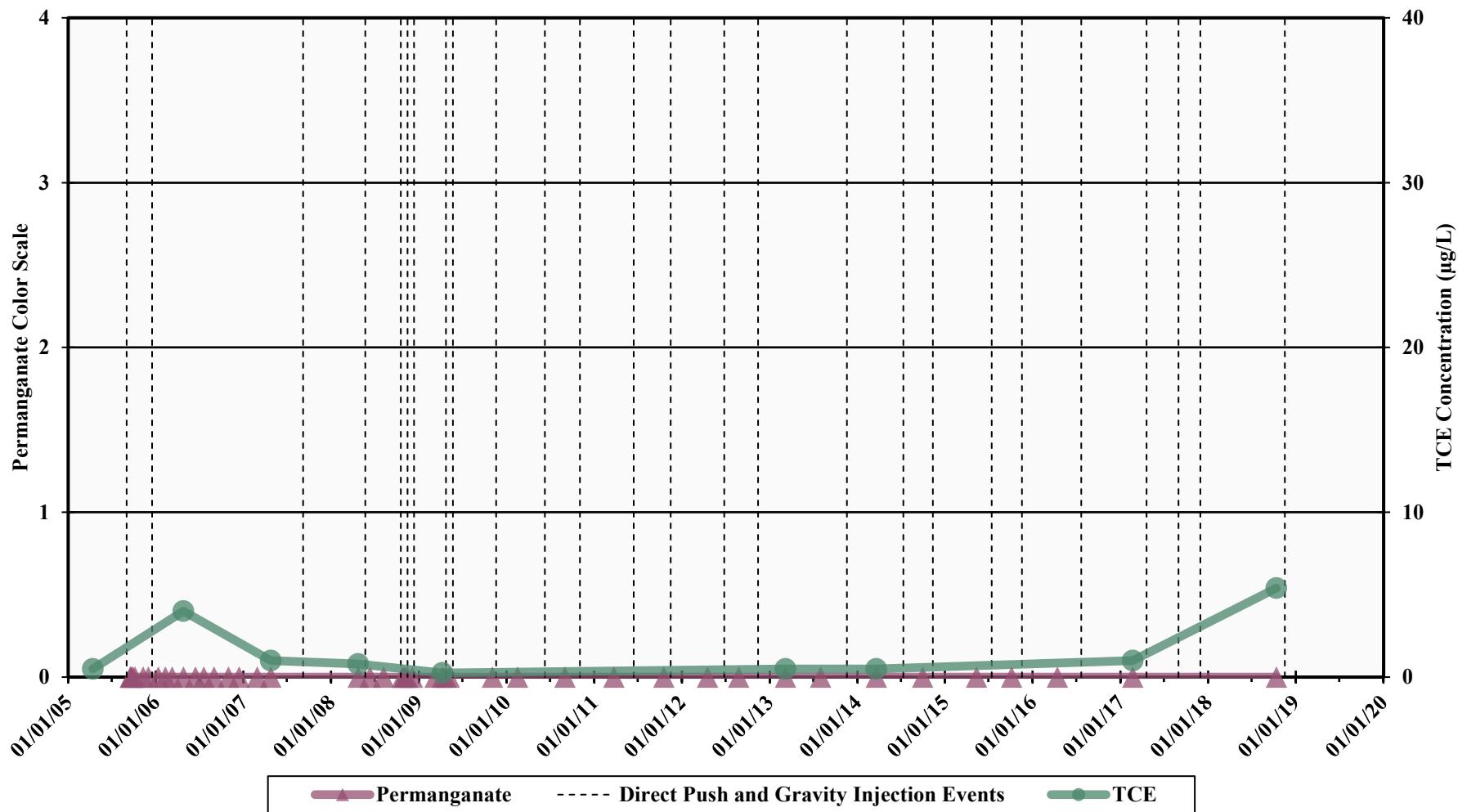
**WELL MW-217M**  
**SODIUM PERMANGANATE AND TCE CONCENTRATIONS VS. TIME**



**NOTES:**

1. TCE = trichloroethylene.
2. µg/L = micrograms per liter.

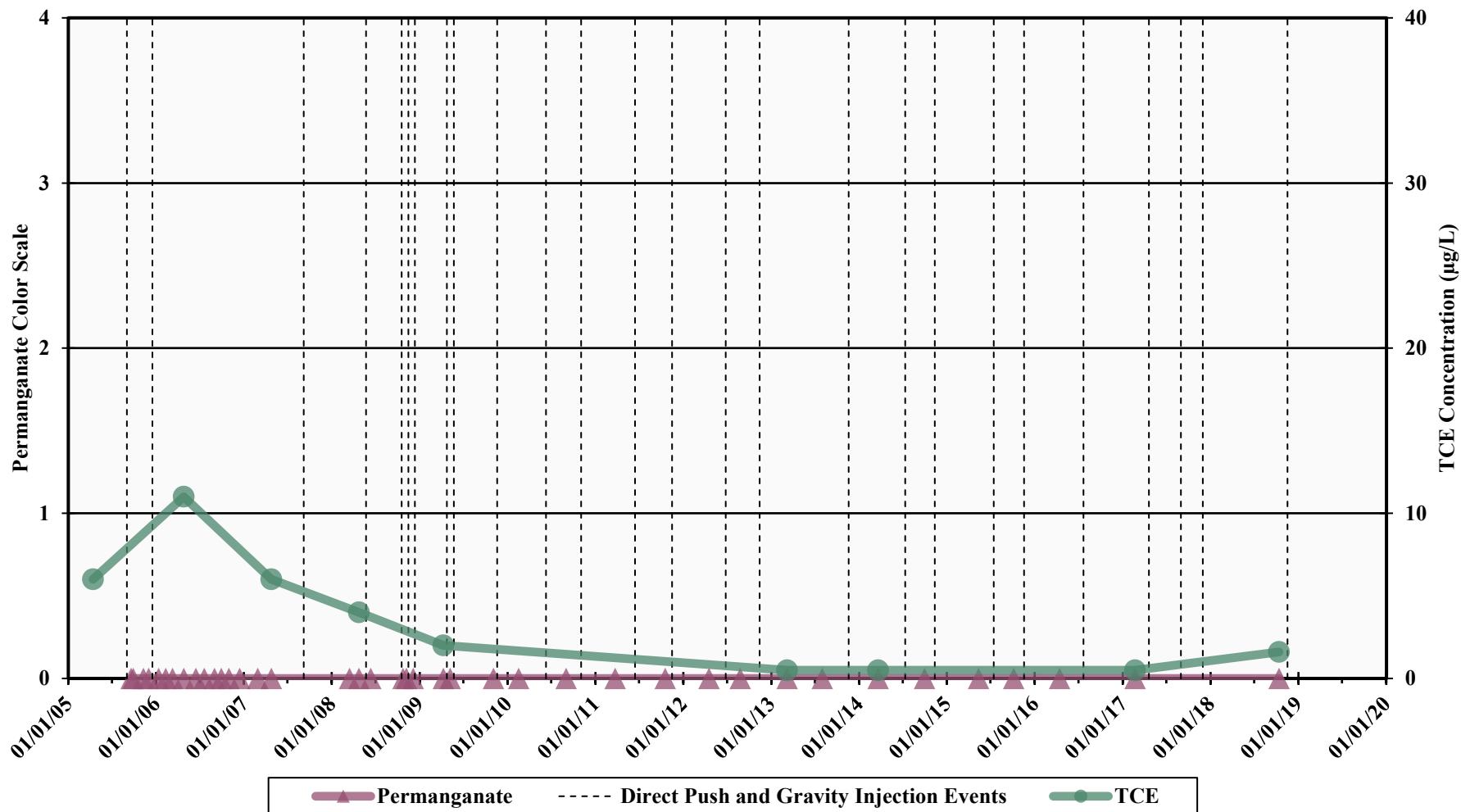
**WELL MW-218M**  
**SODIUM PERMANGANATE AND TCE CONCENTRATIONS VS. TIME**



**NOTES:**

1. TCE = trichloroethylene.
2.  $\mu\text{g/L}$  = micrograms per liter.

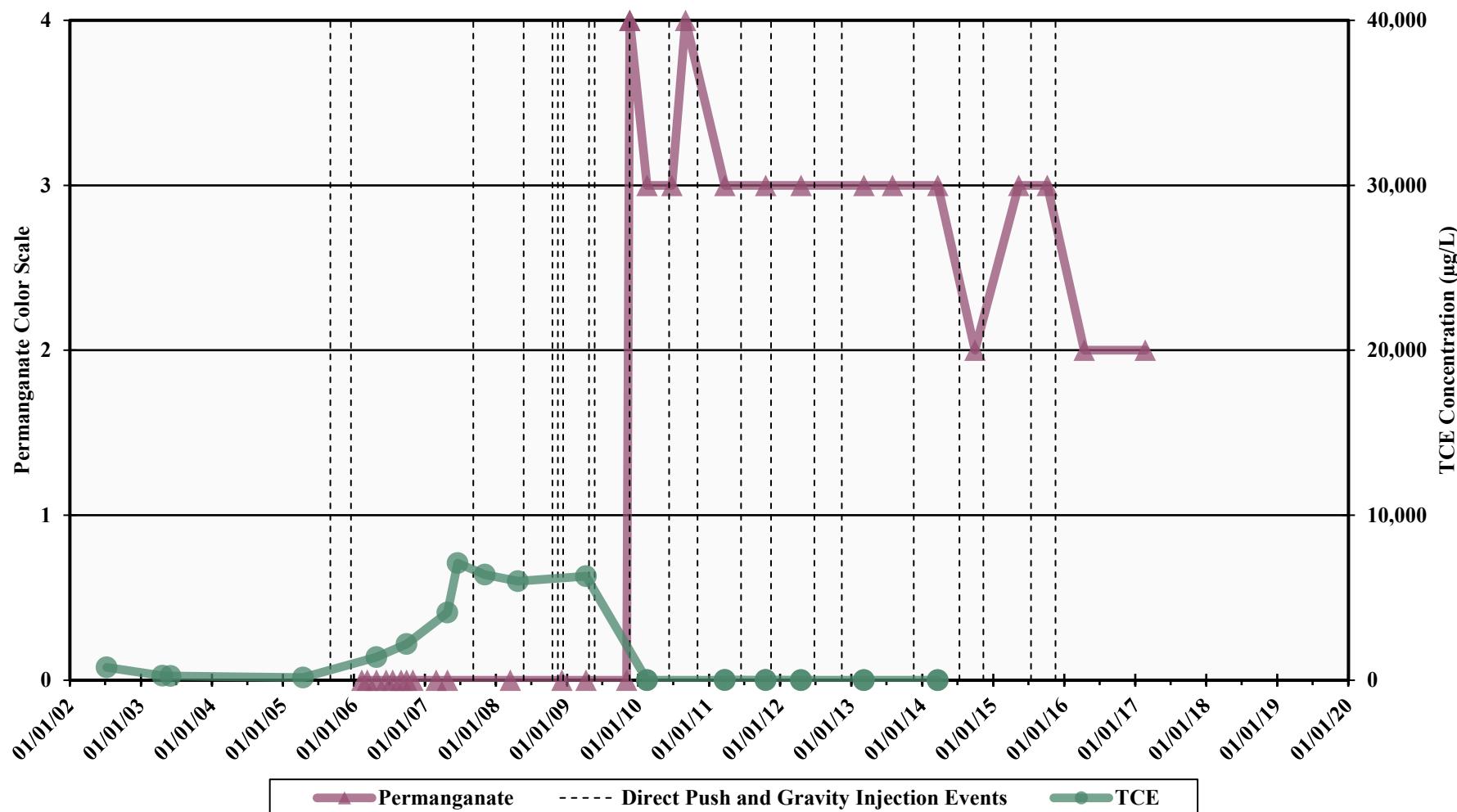
**WELL MW-219M**  
**SODIUM PERMANGANATE AND TCE CONCENTRATIONS VS. TIME**



**NOTES:**

1. TCE = trichloroethylene.
2.  $\mu\text{g/L}$  = micrograms per liter.

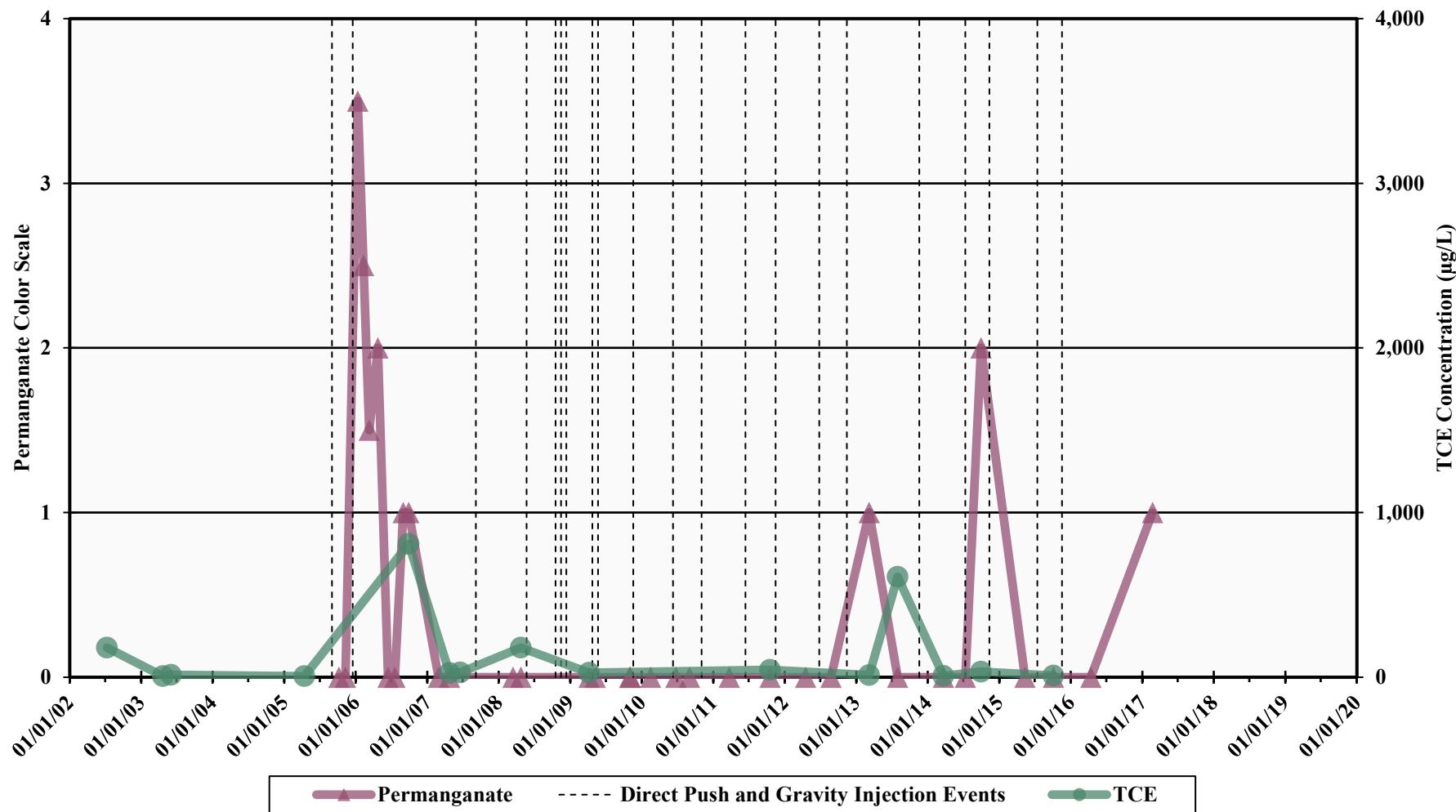
**MW-13**  
**SODIUM PERMANGANATE AND TCE CONCENTRATIONS VS. TIME IN SHALLOW WELLS**



**NOTES:**

1. TCE = trichloroethylene.
2.  $\mu\text{g/L}$  = micrograms per liter.

**MW-014S**  
**SODIUM PERMANGANATE AND TCE CONCENTRATIONS VS. TIME IN SHALLOW WELLS**



**NOTES:**

1. TCE = trichloroethylene.
2.  $\mu\text{g/L}$  = micrograms per liter.